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Engineering News-Record

From France:

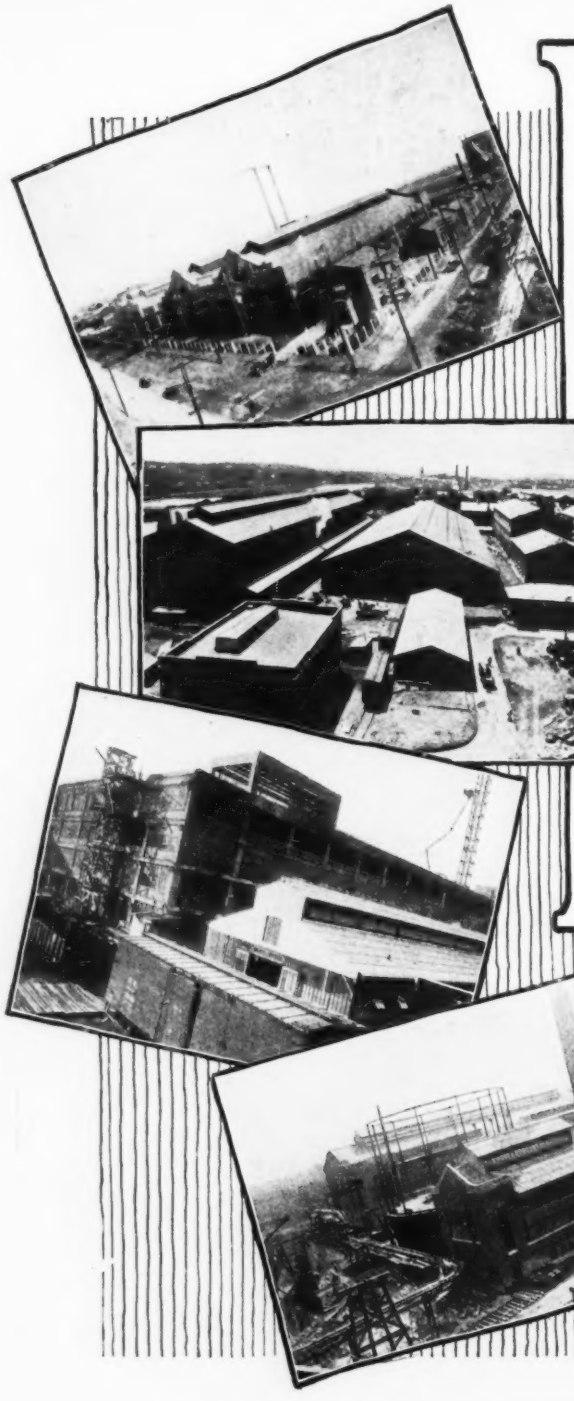
Notes on Reconstruction in the Devastated Regions

By E. J. Mehren
Editor of
Engineering News-Record

Economic Study of Highway Location and Grades as They Affect Motor Operating Costs

By W. G. Harger
N.Y. State Highway Commission

Cover Illustration:
Chuting Concrete for Big Australian Grain Elevator



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN
Editor

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An Economic Study of Highway Design

JUST how far highway engineers have been able to go in spending money to reduce highway grades, and to what extent outlay of money to secure better locations are economical from the viewpoint of motor operation, have always been more or less indeterminate questions. Wilson G. Harger, former senior highway engineer, Bureau of Public Roads, begins in this issue the first of a series of three articles upon motor operation costs as affecting highway location and grade design. In these articles Mr. Harger presents definite data upon the capitalized value of saving in motor vehicle operation costs due to shortened distances and grade reductions. As the first or at least one of the first thorough economic studies of the kind the articles deserve attention.

New Partners in City Planning

CITY planning is being quickened and stabilized by the increasing interest in it shown by the realty operators—or "realtors" as they call themselves. A few years ago, representatives of realty organizations were given an important place on the program of the City Planning Congress. Since then these bodies have been featuring city planning on their own programs. At St. Louis, in June, the National Association of Real Estate Boards not only listened to an address by a city planning consultant but they also received a report from their own City Planning Committee. This report, according to a press summary, "urged greater activity in city planning" and condemned "the property owner who through short-sightedness, stands in the way of greater beauty and utility in city arrangement." No stronger allies for city planning could be found than realty operators once they were filled with sound ideas on the subject and gave it their hearty support. Heretofore many of them have been blinded to the ultimate interests of themselves and their clients through a desire for immediate profit regardless of the future welfare of themselves and their city. There have been notable exceptions as witness the volume entitled "Principles of City Land Values," by Richard M. Hurd, (see Engineering Literature Supplement to *Engineering News*, March 17, 1904). Municipal engineers should seize the opportunity to co-operate with local real estate men, as individuals and organizations, to further intelligent city planning.

Realtors Promote City Zoning

A FURTHER illustration of the growing interest of real estate organizations in city planning is afforded by the existence of a zoning committee of the Real Estate Exchange of Birmingham, Ala., which has collected data on zoning from other cities for presentation to the exchange. Since zoning places such restrictions on the use of land as may readily prevent the sale of plots, it might be supposed that real estate men would be against it. But the farsighted view is becoming more and more common and many realtors are helping instead of hindering the zoning movement that is now sweeping over the country. This is most encouraging.

Production and Transportation

THE fact that distribution is an important supplement of production and that the two are interdependent features of equal importance to commerce is not realized as generally as it should be, but it is being shown very forcibly by the present condition of railway transportation systems. Products badly needed in various sections of the country are either held because they cannot be shipped or are making snail-like progress to their destination. Under such conditions any marked increase in production serves mainly to increase the congestion of storage and transportation facilities. It has been urged, in fact, that the interests of the country demand immediate increase in transportation capacity rather than increased production, since products already have overwhelmed the railways with business. Inland waterways offer practically no relief. Highway and electric railway transport, important as they are in local and short-haul service, can effect only slight relief in the handling of the vast volume of freight. Distribution may be divided into long-haul service—or transportation—and local transportation. Along the same line of thought may be noted a recent paper on "Distribution and Warehousing" by Charles H. Moores, warehouse engineer, who states that the distributing branch of the warehouse business has been developed only in a few of the largest cities and that 60 per cent of the men operating merchandise warehouses are unaware of the great possibilities of organized distribution service. As an example he suggests that a number of warehouse firms operate a motor truck service and call the attention of shippers to its advantages as compared with reshipment by railway to local points. It is important, however, that railway men also should comprehend the possibilities of utilizing motor trucks for terminal transfers and the shorter hauls.

Simplifying Concrete Design

REINFORCED concrete is a variable material. Its physical properties are subject to all manner of change due to ingredients and methods, and actual placing is never accurate. Design, that is the prediction of stresses, must therefore always be approximate and dependent on the factor of safety. Lately, however, there has been a tendency to carry theory too far and to design much closer than the structure itself can be built. Were this careful designing and detailing not expensive in time and effort it might be defended, be-

cause, regardless of the variations in the materal, the closer theoretical stresses can be predicted the more dependable will be the factor of safety used. But there comes a point where economy and common sense demand simplification. Too many designers see the reinforced-concrete beam as a precise rectangle with clearly defined loads and nicely placed heavy lines indicating reinforcement. Such designers are too careful. They may go so far as one who has recently argued that the difference in stress in the upper and lower semi-circles of the tension rod section must be taken into account because obviously in bending such stress differences exist, or they may carry the theory of stirrup location to the point of the placing of the stirrups at the exact center of gravity of the successive trapezoids of the shear diagram. This latter offense results in about one diagram a week being submitted for publication to this journal. Stirrup design at best is a debatable subject, and stirrup location in the field highly elastic. So far as the safety of the structure is concerned some elementary calculations of size followed by location almost by eye will serve quite as well as elaborate computations or tedious following of tabulated or diagrammed data. Most designing offices follow some such scheme. Why should it not be recognized in the literature of the subject?

"France Will Rise Again"

FOR a number of weeks *Engineering News-Record* has been publishing, under the heading "Notes from Foreign Fields," a series of impressions by its editor, E. J. Mehren, who is making an extended trip in Europe. His comments, up to date, have dealt exclusively with things British—the highway problem, English engineering societies, construction methods and other subjects. Mr. Mehren crossed the Channel several weeks ago, and in this issue appears the first of his comments on conditions in France. He deals with that country's biggest question—the status of reconstruction—and his observations are based upon a tour of the devastated regions, including landmarks such as Ypres, St. Quentin, Amiens, Albert, Arras, Lens and Lille, which the World War has made famous for all time.

To engineers generally, and especially to those members of the profession who served with the American Expeditionary Forces and, under the stress of conflict, traversed much of the ground covered by Mr. Mehren only a few weeks ago, the story of France's progress in emerging from the ruins is of intense interest It is true that a comparatively small number of our overseas forces had the opportunity of seeing the devastation wrought by the enemy in these sectors of northern France. The greater part of the line in this region was held by the British, the Belgians or the French, our own operations centering principally in the east in the region of St. Mihiel and the Argonne. To certain of our troops, however, and among them several American engineer regiments attached to the British forces, the scenes depicted by Mr. Mehren bring back vivid memories. It was in the region of Ypres and, in fact, along the whole battle line extending south through the Somme Valley, that the greatest destruction to French towns was done. It is true that a vast amount of labor must be expended to repair the damage done in the Argonne region where our troops saw their greatest action, but as a general rule the havoc wrought by shell-fire in the Argonne, due to the comparative rapidity of our advance, does not approach in volume and in completeness that done in the Flanders region and throughout the north of France. It is here that France's greatest effort now is demanded.

Of the outcome there can be little doubt. Mr. Mehren's message of the progress being made to restore the devastated regions is truly inspiring. For some time after the armistice when, as was natural, everything was in a state of disorganization and France was seeking a well-earned breathing spell after her terrible struggle, progress in reconstruction took the form of words and plans rather than actual accomplishment on the ground. The reading of the article in this issue, dealing with the work at Lens, however, indicates clearly that conditions have changed and that actual results are replacing talk and "projects." The fact that on the first of May 43 per cent of the shell-torn farmlands had been cleared and put under cultivation is a fact of great significance to any one who saw that territory in 1918, for it tells the story of a supreme effort to restore conditions to their pre-war status.

From other figures cited in the article it is apparent, also, that the vital task of rebuilding the roads, of getting the railroads back into service, of clearing the land of shells and barbed-wire entanglements and of filling in the trenches is going on apace. Shattered houses in the towns and villages are being made habitable, but it is natural that this work should proceed slowly and it will be many years before the traces of the shelling to which they were subjected will be removed.

More important, perhaps, than the physical evidences of the fact that France is emerging from the ruins of war is the spirit in which the people are attacking the stupendous problem of bringing a semblance of order out of chaos. France is hard at work. Union hours, according to Mr. Mehren's observations, are practically unknown and the noise of the carpenters busy on the repair of buildings begins early in the morning and continues until nightfall. The fact, too, that in the ten devastated departments 3,967,000 people were residing on April 1 of this year, as against 1,944,000 at the time the armistice was signed, is an index of the spirit of determination with which the French nation is "carrying on." Seeing evidences of this courageous attitude throughout his travels, it is not strange that Mr. Mehren should write "France is rising—rising rapidly."

Transportation Development in Thinly Populated Countries

THE provision of transportation facilities needed to encourage the settlement and development of lightly settled but productive country is a difficult problem in view of the cost, the great distances, the demand for branches and cross-country connections as well as for main routes, and the light traffic that must be expected for several years. In encouraging the settlement and development which has been interrupted seriously by the World War the government of the Union of South Africa and its protectorates is encountering this problem, as outlined in a report which is abstracted on p. 103. In this case there is the further condition that the matter is in the hands of the government, which must balance the needs and desires of the country against the problems of taxation and finance.

Roads as auxiliary to railways are discussed in the

report, but highway development in South Africa is in its earliest stages, with no definite plan or policy yet formulated. One result of government ownership of the railways is a public argument that in districts not yet supplied with communication the railway department should build highways. It is not difficult to answer this argument. For one thing, there is the essential difference that a direct charge is made for the use of railway facilities and the returns are expected to approximate the expenses, even if they do not show a profit. But highways, on the other hand, are provided for the free use of the public, except so far as taxes may indirectly bring some return to provide for maintenance and extension. There is the possibility of adopting the turnpike system, but this appears to be practically obsolete.

Light railways as an auxiliary means of developing the transportation system at low cost in sparsely settled districts are not touched upon in the report. This seems to be a rather strange omission, especially as such lines would logically be handled by the Railway Department independently of the highway problem. It is probable, however, that they would be a drain upon the resources of the Railway Department rather than productive of revenue, and that the benefits accruing to the districts served and to the country at large would not appear in the financial reports of the Department. In what relative degrees the railway system is to be regarded as a source of revenue and as a means of development is a question for the government. Much has been done in the construction of light pioneer railways in countries having conditions comparable with those of South Africa. In this connection reference may be made to recent Canadian projects for light narrow-gage temporary railways to open up communication in advance of permanent railway construction.

To sum up the transportation problem of South Africa, so far as it can be determined from the report mentioned above, it appears that there is need for the prompt initiation of a definite and vigorous policy of highway construction as a matter of public benefit. Further, the development of both road and railway systems offers opportunities for promoting the growth and prosperity of the country. It may be that this indicates a new field for the American engineer, contractor and manufacturer.

The Chicago Drainage Canal Decision

NAVIGATION rights and the power of the War Department to protect them are held to be supreme by Judge Landis, of the U. S. District Court, in his Chicago Drainage Canal decision (see p. 107). Under the law, the judge holds, Chicago's plea for protection to its water supply has no standing. He does not pass on the strength of the plea. He rules out any such plea, as not within the cognizance of the law governing the case.

The decision settles nothing. It is merely another step in a controversy so long drawn out that only those specially interested remember its origin or are even aware of its existence. If the United States is as long over the case on appeal as was the lower court, any one of many things may have happened before a final decision is reached. One of these will probably be a compromise of some kind under which the Chicago Sanitary District will build or pay for lake regulating works and be permitted to use its drainage canal to its full capacity. Another will almost certainly be the construction of sewage-works to lessen the increasing burden on the canal due to the rapid growth of Chicago. A remoter possibility is that Chicago will win Congress to its way of thinking that sanitation should be superior to navigation in this case. Most remote and unlikely, a Secretary of War may come into office who will depart from the rulings of a long line of predecessors.

The Chicago Drainage Canal has raised many broad and serious questions of sanitation, navigation and power, besides governmental questions—local, state, national and international. All center in the one primary question: The right in law and equity of diverting water and sewage from one natural drainage system into another and thus changing the order of nature and impairing whatever rights in law or equity may be involved. Such a main question, with its many subsidiaries, cannot be left to the decision of any one city. It becomes a state, or a national, or an international question, according to the circumstances of each case.

Unfortunately for Chicago, it does not seem to have foreseen the necessity of going beyond its State legislature for authority when it launched an unprecedented drainage canal project with interstate and international reactions. When Chicago came up against the United States in the injunction suit brought by St. Louis on sanitary grounds, it won a Scotch verdict, but it fared differently with the War Department which has persistently and consistently refused to grant Chicago all the water it wants to divert from Lake Michigan.

Without presuming to pronounce on the magnitude of the effect of the drainage canal upon the levels of the Great Lakes, and thus upon navigation, we have no hesitancy in saying that petty and in some cases almost imaginary navigation interests have always been and still are made paramount to other and far greater interests because of the rigid interpretation and enforcement of laws and rules established when navigation was of importance and highway and railway transportation were in their infancy. Traffic changes and perhaps changes in sanitary conceptions and needs demand a reconsideration of some of the ancient rules to protect navigation. But obviously there must be some limit set on the uses of water for other than navigation purposes. Otherwise Chicago might claim a continuing right to water for sewage dilution proportioned to its increasing population. Other cities, too, might put in claims for the use of water for one purpose or another.

Finally, whatever engineers of today, possessed of the existing body of sewage dsposal data and confronted with the millions of population soon to be served, might decide if they were to attack de novo the Chicago sewage problem, we cannot but have admiration for the conception, design and construction of the Chicago drainage canal. It is based on the sound principle and practice of disposal by dilution. It has worked sanitary marvels for Chicago, including a probable very large part in the reduction of Chicago's long-time high death rate. That it has injured either navigation on the one hand or, on the other, the health of the people in the Mississippi Valley, has not yet been proved. What injury in both directions, and to power on the Niagara and St. Lawrence Rivers, might be wrought if Chicago could take all the water for the canal it might take if under no check, is another matter. Ample checks exist, so there need be no fear on that score.

CLEANING UP DEBRIS AT YPRES AND TYPES OF CONCRETE SLABS AND CORRUGATED IRON HUTS BUILT

Notes from Foreign Fields—"Lens Will Rise Again"

BY E. J. Mehren
EDITOR ENGINEERING NEWS-RECORD

EDITOR'S NOTE—*This contribution of Mr. Mehren's series is published out of its regular order because of the intense interest attaching to the reconstruction in France. It was written in Paris, June 25, immediately after Mr. Mehren had completed a tour of the devastated regions.*

ON top of a heap of brick and stone that was the Hôtel de Ville (the town hall) at Lens I saw three days ago this sign in French: "Lens Will Rise Again." Round about was the most hopeless ruin I have seen in the devastated regions. Scarcely a wall of arms-length height can be found. Destruction—utter destruction!

CATHEDRAL AT YPRES

Yet on the highest heap of debris stands the sign of courage and confidence and dogged determination—"Lens Will Rise Again."

And that is written across the whole of the north of France—*France Will Rise Again*, not by words, but by deeds.

France is rising from her ruin. France's scars of war are disappearing. France is repeating the days when her recuperative power astounded the world. She is making another record—a record that will eclipse that of the seventies.

Strange words, these, in view of the tales we heard of a nation exhausted, unable to rise unless helped by other lands, and particularly by the United States.

Yet this evidence is here and none can dispute it.

I have covered the ground north of Paris—St. Quentin, Chauny, Noyon, Amiens, Albert, Arras, Lens, Lille, and up into Belgium, around Ypres. I have talked to engineers and contractors who have covered every mile of ground from Verdun on the southeast to Ostende and Zeebrugge on the Channel, among them Charles A. Stone, of Stone & Webster and the American International Corporation. Their testimony bears out that which I have seen. France is rising from her ruins; she is earning again the admiration which she won in her recovery in the seventies and in her stubborn resistance in the four years of war.

True, the signs of battle are not wiped out; they will not be wiped out for many a year. True, also, that one can conceive of the work going faster; but unaided, using only her own resources, short of men and materials and transportation facilities, she has restored life in the devastated regions, she has cleared 85 per cent of the farms of projectiles, and this season (up to May 1) had put under cultivation 43 per cent of all the devastated lands.

Let me repeat that and write it in italics—*In less than two years after the cessation of hostilities, 43 per cent of the churned-up, desolated farming land is producing crops.* The additional land put under cultivation since May 1 has probably raised the percentage to 60 or 65.

Let me make it stronger still and hammer it home: At this very hour—I take the statement from an official document issued June 20—the ten devastated departments are producing enough cereals for their own needs and may, in fact, be able this year to send cereals to the rest of France.

France Is at Work

The villages, of course, are still in ruins; the industries are barely getting started; the peasants are living in all sorts of improvised shelters, from tar-paper-covered shacks to old army barracks and corrugated-iron-roofed huts with low sidewalks of concrete. For many a year they will live in these temporary dwellings; but they are at work, they are producing wealth, they know no union hours, they are not complaining—they are just doggedly at work, pulling their destroyed territory out of the chaos in which it was engulfed.

I hope I will not be mistaken. Northern France today is not a country in which one would freely choose to live—unless to help pull in the yoke with these courageous French peasants. The cities are still liberally strewed with ruins; Lens and Albert and Bapaume and other cities are still flat; the villages are brick heaps, save for the temporary huts—but the region that was dead has been reborn, the life that was gone has returned, the upheaved soil is coming under the plow and producing crops, the villages are rising again, the less damaged buildings in the cities are being *rapidly* restored (yawning gaps in street-rows will be there for years), and the hum of industry is heard.

A few figures will help to carry the tale to those who cannot come to see:

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ONE OF THE FIRST TEMPORARY SHELTERS BUILT AT LENS

The population of the ten destroyed departments, reduced on Nov. 1, 1918, to 1,944,000 has risen (as of April 1, 1920) to 3,967,000.

Life has been resumed in 4,000 *communes* where it was extinct, or practically so. Of 6,445 schools before the war, 5,345 have resumed their duties, generally in temporary buildings.

Nearly 1,700 co-operative reconstruction societies have been organized and 141,000 persons are engaged in reconstruction operations.

Out of 3,950,000 hectares of land to be restored, 3,339,000 had, on May 1, 1920, been freed of projectiles, 2,780,000 had been cleared of barbed-wire entanglements and 1,680,000 had been ploughed for the first time. The progress in the seven weeks since these figures were compiled has probably brought the ploughed percentage to 60 or 65.

Of 265,000,000 cubic meters of trenches 156,000,000 had been filled, and of 300,000,000 meters of barbed wire entanglements, 203,000,000 had been taken up. A total of 15,350,000 cubic meters of débris had been dis posed of, out of a total of 41,000,000 cubic meters.

In all, 297,000 houses had been totally destroyed, and 277,000 more damaged. Of the latter, 185,000 had been put in livable condition. Moreover, 28,500 wooden huts, 28,200 temporary wooden houses of fair construction, and 16,800 temporary houses of brick, concrete slabs, etc., had been erected.

Of 51,547 km. of highway needing repair at the time of armistice, 17,789 had been put in temporary condition, and 2,265 had been completely restored. Seventeen hundred culverts and bridges out of 3,168 had been replaced, most of them with temporary structures.

The main-line railroads, whose length I have been unable to secure, had been completely restored, as had also the canals. The branch railway lines to the extent of about 60 per cent had been put in condition to permit operation and some 391 km. out of 2,386 had been completed. Of industrial establishments, 2,627 out of 3,508 had resumed operation by May 1. Production is not at pre-war capacity, but the wheels of industry are again moving.

All this France has done by herself—practically unaided. She has done it because of the energy and devotion and courage of the people of the devastated regions, backed by the whole of France.

I was awakened by carpenters at 7 in the morning; I saw them rebuilding industrial plants as I went in to dinner at 7 in the evening.

The peasants stop only at nightfall.

Yes, "Lens Will Rise Again." *France* is rising—rising rapidly.

PARIS, June 25.

Machine for Forest Products Laboratory

Tensile, compressive, and bending tests up to 1,000,000-lb. load can be carried out on a new vertical screw-power testing machine just built for the Forest Products Laboratory, Madison, Wis. One or two earlier machines of the same general type and of the same capacity has been built, but the present machine is of somewhat wider range of use. Its overall height is 45 ft., of which 37 ft. is above the level of the table, and its floor plan is 15 ft. x 10 ft. 8 in. It will take columns up to 30 ft. long; when arranged for tension tests the pulling head has a maximum travel of 29 ft. In transverse testing it can take beam specimens up to 10 ft. long. The upper or weighing head can be fixed at several different elevations, to adapt the machine conveniently to different lengths of specimens; two keys passing through openings in the weighing column hold the head. The weighing mechanism is independent of the power mechanism. Readings on the beam are by 10,000-lb. increments to 1,000,000 lb., a micrometer dial giving the readings from 100 to 10,000 lb.

Cold Weather Troubles Encountered in Water-Works Operation

Slightly Condensed from Report of Committee on Cold Weather Troubles, Charles R. Bettes, Far Rockaway, N. Y., Chairman; presented at June Convention of American Water Works Association.

THE Committee received 85 replies in response to its questionnaire regarding the cold weather troubles of 1917-18. The information has been tabulated and is filed with the editor of the *Journal* of the association. The data is interesting and valuable but lack the uniformity necessary to make a comprehensive comparison, and the Committee did not feel that the data were such as to warrant the expense of printing.

Temperature — Extreme low temperatures prevailed throughout the country during the winter of 1917-18. Unfortunately, the replies to the questionnaire seldom gave temperature where trouble was experienced and did not indicate the close relation between trouble and temperature that one might expect. Trouble was experienced in comparatively high temperatures in some localities and none reported at low temperatures in others, without any explanation of this unusual condition. In few cases was the depth of snow mentioned. Nearly all reported an increase in consumption during the cold period.

Depth of Pipe Cover—The data on depth of piper covering were interesting but not conclusive except in emphasizing the need of giving special study to local conditions. Pipe having a covering of 54 in. of coarse gravel froze while pipe having only 24 in. of cover, but laid in wet ground, escaped. The size of the pipe and circulation being the same, it is reasonable to suppose that the nature of the covering material accounted for the difference.

Thawing Methods—The data on thawing were more complete. Forty-six replies reported in more or less detail the use of electrical current in thawing; 22 reported as to other means, etc. Important details, however, were lacking in many cases. In 53 of the cases the information was not comparable. Steam was used successfully in a number of cases. The majority of replies clearly favored the use of electrical thawing and indicated that this method afforded advantages both as to cost and efficiency. The cost data were incomplete, a few replies only giving details as to length or size of pipe, time, etc. The cost for services ranged from $1.90 to $139 per service; and the time from thirty minutes to two days. In general, it may be said that the expense of thawing a service was under $9 and the time required less than one hour. In the majority of the cases reported the current was taken from the local lighting company; 14 water companies did their own thawing; and in five cases the work was done by plumbers. The current used ranged from 5 volts and 150 amperes to 125 volts and 600 amperes. Storage batteries were used to some extent. There is a possibility that the use of electrical current may damage the pipe and connections. We recommend that those using this method carefully note the effect with a view of subsequent report to the association. Many automobiles were converted into effective thawing outfits; and there are undoubtedly possibilities in this line.

The committee endeavored to obtain from manufacturers specifications for an outfit, low in first cost, light in weight, simple and effective, that could be easily transported by sleigh or auto and operated by gas engine or the auto engine itself. We believe there is a market for such an outfit and hope that the manufacturers will give the matter earnest consideration. The committee recommends a generator operated by a gas or oil engine, set on an iron frame, equipped with rheostat, automatic circuit breaker, voltmeter, ammeter, cable, etc., all to be mounted on a trailer or sleigh, and further suggests the use of a current of from 30 to 50 volts and 130 to 400 amperes. There should be a rheostat control to permit increase or decrease in the voltage without interfering with the proper operation of the outfit. By proper manipulation such an outfit should do both for services and for reasonably sized pipes and if properly and carefully handled, would be safe and effective. It was suggested that where high voltage current was available, an A. C. transformer be held in reserve so that if more convenient, current could be taken from the power company. The manipulation in this case should be entirely under the control of the power company. It must be borne in mind that in the use of any electrical current for thawing there is definite risk and that care and common sense must be exercised.

Services Need More Covering—The greatest cold weather trouble probably comes from frozen services, at least the greatest "kick" comes from this source. The service pipes are seldom laid as deep as the mains and often with much less covering—exactly the reverse of what it should be. Not infrequently the tap is made near the top of the main and the goose-neck is perhaps 4 to 8 in. above the main. Services should have more covering than the mains and should be carefully inspected, especially if laid by plumbers. A main or service that has once given trouble should be lowered to prevent a repetition.

Fire Hydrants—A frozen service is more or less inconvenient but a hydrant out of commission creates a serious risk. Hydrants should receive special attention and every hydrant on the system should be inspected late in the fall. The drip should be open, if the hydrants are set so they can drain. If set in water, the drip should be plugged and the hydrants pumped out. Those on dead ends should be packed. Where it is necessary to take these precautions, hydrants should be inspected frequently. There should be a rigid rule to prevent unskilled or curious people opening hydrants during cold weather "to see if water will run"—a not infrequent cause of trouble.

Frozen hydrants were reported successfully cleared by steam, hot brine, calcium carbide, alcohol or by building a fire about them. No information was given as to the effect of salt or carbide on the valves. Alcohol was reported as giving satisfactory results but it is rather expensive and since the prohibition amendment might be considered unsafe; not, however, as unsafe as the practice of building fires. Ordinary hot brine will do good work. If the trouble is in the branch, salt and carbide are said to be effective.

A Local Problem—The operating man must study the conditions in his locality and solve them as a local problem and not be governed too much by what may be good practice in other localities. This refers not especially to cold weather troubles (which after all are of comparatively small moment) but to the operation of the entire plant. The actual number of services, hydrants and mains frozen is a very small per cent of the whole, and indicates that water works in general are as efficiently managed as other businesses.

Floating Jib Crane of 200 Tons Capacity

In building a steam-power floating crane for very heavy lifts for the Cammel, Laird & Co. shipyard, at Birkenhead, England, the builders, Cowan, Sheldon & Co., Ltd., of Carlisle, adopted the luffing-jib type but without rotation, the jib being hinged directly to the tower fixed to the deck of the scow. The crane has a lifting capacity of 200 tons at 65-ft. clear reach beyond the end of the scow, and with capacity for 30 tons lift on an auxiliary block at a reach of 97½ ft. clear. The forward post of the tower, carrying at its top the end pin of the jib, is set 35 ft. inward of the forward edge of the scow. The main hoist consists of two separate 100-ton blocks, which for joint lifting are coupled by a crosshead. The rate of lift at maximum capacity is 8 ft. per minute, while the 30-ton auxiliary hoist has a lifting speed of 40 ft. per minute. Luffing for hoisting the jib is done at a rate requring 20 min. for the full range of about 50 deg. vertical angle, under maximum load. Outline drawings of the crane and a brief description are given in *Engineering* of June 25, 1920.

Road and Railway Transportation in South Africa

Relation of Government Owned Railways, Roads and Motor Service in Developing New Lands for Settlement and Farming

INCREASE in transportation facilities to promote the development of the country is a problem before the government of South Africa. In addition to the continual demand for railway extension there is a growing demand for a system of public roads to supplement the railway system. These two factors of the transportation problem, together with the relations between them, are discussed in a report by Sir William W. Hoy, general manager of the Department of Railways and Harbors.

Highway development appears from the report to have been left to local authorities, which have not been able to make much progress. It is pointed out by Sir William Hoy, however, that highways constitute a national rather than a local consideration, because the prosperity of the country depends upon the development of its material resources, which in turn depend largely upon the provision of transportation facilities. Owing to the long distances with consequent heavy expenditures for both construction and maintenance in relation to a thin and scattered population it is considered that proper development of the highway system is beyond the financial limitations of local authorities and that therefore the government should provide at least main roads sufficient to develop the resources and increase the prosperity of districts upon which road taxation must be levied.

It has been suggested that road construction in country districts not served by railways should be undertaken by the Railways and Harbors Department, as other government departments are not in financial position to assume the responsibilities, while both roads and railways are factors in land transportation. Sir William Hoy dissents from this view. He states that road construction and control are not properly functions of a railway system and that users of the railways would object to paying largely increased rates and fares in order to provide money for highway work. Furthermore, he points out that though there may be advantages in grouping roads and railways in one department, the financing of the two systems must be kept separate. He is not prepared to say that co-ordinated control of roads and railways is necessary in South Africa, but he considers that a present and absolute necessity is a progressive road policy controlled by an authority having sufficient financial resources for a general program of development.

On the other hand he argues that no railway system, however complete, will suffice to meet the transportation needs of a country, whether thinly or thickly populated. Even allowing for an extensive and continuous program of construction, many districts of South Africa will have to wait several years before they have railway communication, to say nothing of the branches and feeders needed to promote and assist development. Railways cannot serve directly all the farms and it will be many years before all farms are even within such close reach of a railway as to make intensive cultivation profitable, to secure economic transportation and to admit of produce being delivered to competitive markets.

That some alternative and auxiliary means of transport is necessary, therefore, it is stated in the report, which discusses motor transport on highways as a possible auxiliary or feeder system, reference being made to the practice of several English railways in operating road motor service in agricultural districts. Flexibility is the great advantage of a service of this kind for collecting products, distributing supplies and handling local traffic in such a way as to meet the needs and develop the resources of outlying districts. But motor transportation requires good roads and in South Africa these exist only in the neighborhood of large cities. Heavy wear and consequent heavy maintenance and repair work on the roads will attend the development of motor traffic and must be considered in any highway program.

A thorough investigation to determine the best means of solving the transportation problem is an urgent necessity, according to the report, which points out that future prosperity depends upon the opening up of internal resources and that the full development of the country cannot be obtained until something is done to improve the transportation facilities.

Light Creosote Oils in Wood Preservation

Light creosote oils properly injected into wood apparently will prevent decay until the wood wears out or until it checks so badly that the untreated portions are exposed. Such is the indication of service records collected by the U. S. Forest Products Laboratory on railway ties and telegraph poles preserved with low boiling creosotes.

Creosotes used in ties from 25 to 50 years ago were for the most part oils having 50 per cent or more distilling below 235 deg. C., with a residue not to exceed 25 per cent at 315 deg. C. The ties so treated lasted from 15 to 20 years, and failure was traceable in most cases to mechanical wear, such as rail cutting and spike killing. In no case was failure found to be the fault of the preservative.

Of 1558 telegraph poles in the Montgomery-New Orleans line, which were pressure-treated with a light creosote oil, 1049 poles were still sound after 16 years. In 91 per cent of the cases of decay the fungi had entered the wood through checks and shakes. Representative sections in the Norfolk-Washington line showed that after 17 years service, of the 1614 poles inspected, 1469 were sound, 92 decayed at the top, and 105 decayed at the ground line. The decay at the top was caused chiefly by cutting off the poles. In those decayed at the ground line, the causes of failure, as determined in 88 per cent of the cases, were checks or shakes. Here again as in the ties, the preservative outlasted the mechanical life of the wood.

The following conclusions are from the Forest Products Laboratory "Technical Notes," recently issued:

"Unless some other factor than protection from decay is considered important therefore, there is apparently no need to specify high boiling oils. The important point is that any coal tar creosote which is not extremely low boiling or extremely high boiling will satisfactorily prevent decay, and in the selection of an oil, factors such as price, penetrability, and convenience in handling should receive greater consideration than moderate differences in volatility."

Motor Operation Costs as Affected By Highway Location and Grade Design—Part I

"Mileage Service" Prime Consideration of General Policy — Extreme Refinements of Location Impracticable—Economic Grade Limits Defined and Recommended Practice Enunciated

By Wilson G. Harger
Former Senior Highway Engineer U. S. Office of Public Roads

MANY engineers, particularly men with railroad training, seem to feel that highway location and grade design should be based strictly upon a ton-mile cost analysis. Very few roads are designed strictly upon this basis, and the writer believes that the reasons why they are not, are sound, except for unusual cases. It is the intention of this article to outline the desirable features of locating from the standpoint of motor operation, and, at the same time, indicate the practical limitations in applying them. Certain general principles can be derived from the laws of mechanics modified by judgment. The data given have been used by the writer for some time as a basis for comparison of routes and alternate locations. The relative operating costs on different grades are, at present, entirely a matter of personal judgment and must be used as such.

Railroads have spent large sums to reduce the ton-mile cost, and in their locations careful comparative estimates are made of construction cost and operating cost. Why is this not done more in highway location, considering the increase in mechanical transport? One of the evident reasons is that railroads get a direct tangible money return in dividends for their expenditure, and the returns to a community on a public road investment are too intangible. It is undoubtedly true that to get the full value of an improved road system the engineering location should be made for the most efficient use of motor vehicles, but there is no possibility of obtaining, nor any justification for expending, extremely large sums to reduce the ton-mile cost below that obtained by the usual modern highway design.

If we had unlimited funds a careful analysis might be carried out on special roads, but we must consider the following fact: The locations of roads in well settled districts are practically confined to existing rights-of-way, except for minor relocations to avoid extreme grades or for reasons of safety. This is necessary, for the community has grown along these well set routes and the principle of direct contact holds. These rights-of-way were not necessarily laid out with regard to economic road location. In fact, they are often arbitrarily fixed by land section lines, or locations where a poor road could be constructed originally without much labor or cost. The cost of new rights-of-way for entire new locations and the difficulties of acquiring them are prohibitive at this stage of development in road building, except in unusual cases. The improved roads of today are only a progressive stage in the development of highway transport. The demand for them and the satisfaction in their use lie mainly in the fact that they provide a firm surface and can be used the year round; that they cheapen somewhat the cost of hauling, that they make the use of light automobiles feasible for long and fast trips. The community is willing to pay a certain amount for the improvement in road conditions which the usual practice in modern road construction gives, but it is not willing to pay large additional sums for further reduction in ton-mile hauling costs. Only a comparatively few men would get a direct benefit from such expenditure. The indirect returns to the community are too intangible. Much of the road traffic is pleasure traffic and a few more gallons of gas mean nothing. If the owner did not spend his surplus for gas he would spend it for ice cream, soda, or the movies. There seems to be no way of making the few road users who would be benefited by a further reduction in hauling cost pay the price of the necessary construction. It may be that for certain toll roads, some time in the future we can use a ton-mile location analysis, but we are not yet up to such a standard.

Mileage Service First Principle

This does not mean that the engineer should not make an effort to get the best possible location, but he should bear in mind that the first principle of general policy considering any comprehensive road improvement program is "mileage service," and he should aim to get the greatest mileage of road that will serve the great majority of road users. Poor grades or poor alignment should never be used on high grade improvements as they are the fundamental elements of design, but there is a limit to expenditures that would further reduce the ton-mile hauling cost.

Saving in distance is valuable; saving in total rise and fall is valuable; and the elimination of sharp curves is desirable. Every effort is made to accomplish these results, utilizing the existing roads where we have to; making minor relocations to avoid extreme grade or danger, because the sentiment of the community approves of these measures, but always bearing in mind that today and for a long time to come mileage is the prime requisite of the programs. It is possible in sparsely settled communities to make reasonable engineering locations but in these districts shortage of funds often plays havoc with our intentions.

It is well to bear in mind what distance saving is worth, and what a saving in total rise and fall is worth. The data given are, of course, of general value only, as the fluctuating cost of motor operation, the types of hauling, and special conditions of all sorts affect the figures. They, however, show in a general way that it is well worth while to reduce traffic losses arising from these elements of needlessly poor location or design. A. R. Hirst gives the above conservative figures on the value of saving distance:

If the very conservative sum of 10c. per mile is allowed for each mile of travel save , the saving of a mile in dis-

VALUE OF A MILE IN HIGHWAY DISTANCE SAVED

Average Number of Vehicles per Day	Saving to Owners per Year	Saving Capitalized at 5 per Cent Equals
100	$3,650	$73,000
250	9,125	182,500
500	18,250	365,000
750	27,375	547,500
1,000	36,500	730,000
2,000	73,000	1,460,000
5,000	182,500	3,650,000
10,000	365,000	7,300,000

tance on highways carrying the foregoing average number of vehicles per day, will save the traveling public the given amount per year, which is the interest at 5 per cent on the amount given in the third column.

The value of eliminating rise and fall cannot be figured with any degree of accuracy, as there are too many indeterminate and variable factors, but in the writer's opinion it is not likely that the capitalized value of saving one foot of rise and fall, per 100 vehicles per day on long routes, will exceed $60 on light grades or $400 on heavy grades. For small grading reductions on short hills the time factor is of no consequence, and the practical value of saving a foot rise or fall is not, probably, more than ½ of these figures. (See Part II of this article.)

It is very evident that considerable expenditure is justified to reduce distance and rise, but it is also evident that it would be impractical to carry this method of location to its logical conclusion by expenditures in any way approximating the figures given. The location of a free public road with no direct revenue return cannot be analyzed from the same point of view as a trunk line railroad. Before large expenditures are made for unusual refinements in location it is just as well to get a reasonably complete mileage of good, usable, firm-surfaced roads, as 100 mi. of the usual modern improved road are more valuable to the community as a whole than 50 mi. of more scientifically located highways. *Needlessly short mileage is the most serious criticism that can be made of any general policy.*

Summary of Motor Traffic Considerations

The design of a highway should, however, comply, as nearly as possible, with the theoretical demands of cheap operation. The principles used in this connection may be stated as follows:

1. The selection of maximum grade within the bounds of standard practice is not affected by the ability of single-unit motor vehicles to climb. Long trailer trains would modify the maximum grade.

2. The selection of maximum grade within the bounds of standard practice does not affect the factor of safe descent.

3. For a fixed rise and fall and distance, a combination of different rates of grade have no effect on fuel consumption. However, the total cost of motor operation, including the time factor, is, probably, slightly less for a uniform grade. This effect is not, however, noticeable enough to reduce the steepest grade below a reasonable maximum, and has no practical effect whatever on the use of rolling grades—as the value of smoothing out a rolling grade becomes less as the rate of grade is reduced.

4. For a fixed rise and variable distance depending upon the rate of grade, the lower the rate of grade the higher the fuel consumption and operating cost. Under these conditions the grade should be kept to the steepest reasonable rate.

5. In the matter of convenience in driving, it is desirable to avoid shifting gears. The grade at which gears are shifted for the ordinary car on improved roads is about 6 per cent—10 per cent for pleasure cars and 5 per cent to 8 per cent for standard trucks. This, however, is subject to constant change and not of much importance.

6. The value of distance saved can be closely approximated.

7. The value of rise and fall saved cannot be closely figured, but it is certain that it has more money value on steep grades than on light grades.

8. In locating roads, distance can be balanced against rise but it is not possible to analyze this closely. As a rule, distance should rarely be increased, particularly if good alignment is lost, unless it is necessary to get a reasonable maximum grade, or unless a noticeable rise and fall can be eliminated by a short additional distance.

9. Ruling grades need not be consistent in rate, so far as ordinary motor traffic is concerned, as they do not limit the load of single-unit motors.

From the standpoint of motor traffic the two most important considerations are short distance and the elimination of needless rise and fall on steep grades. Rate of grade or the elimination of rise and fall on light grades has very little effect.

Effect of Grade Selection

With the data at hand it is not possible to analyze the cost of motor operation closely for different rates of grade, but certain fundamental principles of road location can be established, by the principles of mechanics modified by judgment. Reduction in distance, time of travel and needless rise and fall are desirable, but it is very difficult to put a money value on such savings, particularly the elements of time and rise.

Practically, a little extra gas means nothing to a large proportion of road traffic, and a little extra time means less, for we all waste much of our time in spite of the teachings of efficiency. Therefore, to attempt to place a construction value on the saving of a little fuel and time hardly looks reasonable for most conditions. Under some circumstances, however, such as long distance main roads, particularly where regular, systematic truck freighting occurs, the time element is a real factor and should be considered. The writer has been in the habit of eliminating the time factor in considering motor traffic on local service roads, but includes it for special service commercial roads. This as a general rule means about twice as much expenditure is justified for saving distance and about three times as much for saving rise on special service roads as upon local service roads.

The discussion is only of general value and will first develop certain principles of location, and then a rough approximation of operating costs on different grades.

Light and heavy trucks are commonly operated on firm surfaced roads up and down 15 per cent grades. Light passenger cars have no difficulty in climbing 15 per cent grades even on fairly poor natural soil roads. The safety of descent depends largely on the condition of the road surface and the brakes, but it is not a noticeable factor in design up to 12 per cent which is beyond the reasonable bounds of modern practice in grade selection. *That is, the factors of climbing power of single-unit motor vehicles, and safe descent, do not affect the selection of grade from the standpoint of motor transport.*

Drivers dislike to be forced into second or low gear. If it is possible to determine approximately the rate of grade at which most cars or trucks shift gear, some information is had on grade selection. It is, of course, difficult to figure this closely, for as motor design improves gear ratios vary. Then cars run on varying degrees of efficiency, gasoline varies in quality, etc., but as a matter of interest the author's experience indi-

cates that the average light pleasure car of the year 1919 shifts into second gear at about 7 per cent and that very little gear shifting is necessary on long 6 per cent grades. W. C. Slayton, a truck fleet manager, says that his 5-ton standard gear ratio trucks generally drop into second at about 5 per cent and that very little shifting would be required on long 4 per cent grades. Passenger automobiles drop into low at about 10 per cent and the 5-ton trucks into low at about 8 per cent.

From the standpoint of convenience in driving pleasure cars these premises, if they apply, indicate that if for any reason a 6 per cent grade can not be obtained you might just as well use a 10 per cent and that heavy expenditure to get a 7 per cent or an 8 per cent has no bearing on the convenience of the road. This applies only to scenic routes. In the same way for truck hauling, if you can't get a 4 per cent there is no object from the standpoint of convenience in using less than an 8 per cent. Other factors, however, apply to reduce this extreme jump as discussed later. It should however be borne in mind that if trucks are operating regularly over a stated route special gear ratios can be and are used to meet the existing grades. Convenience therefore plays a minor part in grade selection.

Fuel Consumption

For an equal distance between terminals and an equal rise and fall the fuel consumption does not theoretically depend on the rates of grade. If, however, the selection of rate of grade affects the distance, but not the rise and fall, the lower rate of grade will increase the fuel consumption. To illustrate: Suppose a tractor is hauling a train of farm wagon trailers on a hard surfaced road; and suppose there are two villages *A* and *B* (see Fig. 1) 10,000 ft. apart and 100 ft. different in elevation. The theoretical energy in foot pounds per ton of load required to haul between these points is for all practical purposes the same for any ordinary maximum grade as shown in Table No. 1.

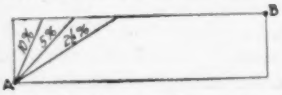


TABLE I.

Rate of Grade, per Cent	Resistance per Ton of Load (Lb.)	Length of Grade to Rise 100 Ft., Feet	Ft.-Lb. of Energy Used to Rise 100 Ft. on Grade Shown	Remaining Distance on Level, Feet	Ft. Lb. to Haul on Level for Remaining Distance	Total Ft. Lb. Energy to Haul from A to B
2½	90	4,000	360,000	6,000	240,000	600,000
4	120	2,500	300,000	7,500	300,000	600,000
5	140	2,000	280,000	8,000	320,000	600,000
6	160	1,666	266,640	8,334	333,360	600,000
8	200	1,250	250,000	8,750	350,000	600,000
10	240	1,000	240,000	9,000	360,000	600,000
Vertical	2,000	100	200,000	10,000	400,000	600,000

Resistance per ton of load on level 40 lb.

If we assume that the fuel consumption is proportional to the energy expended, Table 1 indicates that under these conditions no appreciable saving in fuel consumption results from the use of a low maximum grade. It is probable, however, that the time factor makes the lower grade somewhat cheaper on which to operate. This adds considerable strength to the contention that very little practical advantage results from reducing grades on local service roads below a reasonable maximum where the rise remains fixed and also indicates that long uniform low rates of grade have no particular added value over a series of grades of different rates provided the rise and fall and distance remain the same.

Now suppose *A* and *B* were only 1,000 ft. apart in distance and 100 ft. different in elevation. A road between them on a 10 per cent grade would be only 1,000 ft. and would take only 240,000 ft.-lb. of energy per ton of load on the trailer. A road on a 2½ per cent grade would have to develop additional distance to rise 100 ft. It would be 4,000 ft. long and would require 360,000 ft.-lb. of energy to haul 1 ton of load. From this it is possible to see that *where the selection of a low rate of grade increases the distance for a fixed rise it increases the fuel consumption.* Under these conditions it is desirable to use the highest rate of grade that will satisfy the other requirements of traffic and construction cost, such as reasonable limiting loads for teams or trailer trains, convenience in the matter of gear shifts and the cheapest construction location and maintenance cost.

Recommended Practice

From the standpoint of horse traffic, single unit motor traffic or trucks with one trailer, safe footing, and economy of construction and maintenance, the rates of maximum grade mentioned below seem reasonable for the great majority of improved roads. In unusual cases the possibility of the extensive use of long trailer trains would tend to reduce these rates. However, the author wishes to emphasize the opinion that it is not likely that the long trailer train will develop as a popular general utility mode of hauling, and while there undoubtedly will be cases where this method should modify the design, it will be the exception rather than the rule. The following rates are satisfactory for usual motor equipment and additional expenditure would not be warrented for the benefit of a few users unless they paid the additional cost of construction—

Main Commercial Roads in Flat Country—Long 2½ per cent maximum grades are desirable but do not justify much additional construction cost. Any long grade up to 5 per cent is satisfactory. Short 6 per cent grades are not consistent.

Main Commercial Roads in Hilly Country (Well Settled districts)—Long 5 per cent maximum grades are allowable and warrant considerable expenditure provided they do not increase the total distance. Seven per cent grades are probably justified to prevent increase in distance. Long 6 per cent grades are fairly satisfactory, but if a 5 per cent cannot be obtained it is just as well to jump to the 7 per cent rate. Short 7 per cent grades are not inconsistent with long 5 per cent rates provided the element of safe team footing is considered.

Main Roads (Pioneer districts)—Long 5 per cent maximum grades are very desirable, provided they do not increase the total distance, particularly if the road is a natural soil road and considerable horse traffic prevails. Any long grade up to 7 per cent is satisfactory. Short 7 per cent and 10 per cent grades in connection with 5 per cent and 7 per cent long grades are justified from the standpoint of all classes of traffic except trailer trains. Grades heavier than 7 per cent are not, however, in much favor on account of danger and high maintenance costs.

Side Agricultural Roads—Any long grade up to 7 per cent is satisfactory.

Scenic Pleasure Roads—Six per cent is convenient; but any grade up to 10 per cent is suitable, provided the alignment is safe.

Consistent Maximum Grades—Considerable expenditure is justified to obtain consistent maximum grades for the benefit of team or trailer-train hauling.

(To Be Continued.)

Six-Track Coal and Water Station for Through Trains

Quick Service for Heavy Traffic on P. & L. E. R.R. With Minimum of Manual Labor—Water Supply Requires Treatment

A LOCOMOTIVE coaling and water station on a six-track line, capable of serving trains at 10-minute intervals in both directions, with a 20-minute stop for each train, has been built on the Pittsburgh & Lake Erie R.R. at Brightwood, Pa., where there are four running tracks and two freight train sidings of 100 cars capacity.

The use of mechanical equipment has made it possible to reduce operating labor to a minimum. Traffic averages 20 to 35 freight trains daily in each direction.

The plant is seven miles west of Pittsburgh and supplants an old one at Groveton, two miles farther west. Coal, water and sand can be supplied to trains on all six tracks, while the four inner or freight tracks also have ashpits where engine fires are cleaned. Three stops are made, one to take water and drop ashes and the others to take coal and sand. Freight trains are frequently operated on the two outside or passenger tracks. A view of the plant is shown in Fig. 1, and Fig. 2 is a general layout plan. A 750-ton reinforced-concrete coal bin spans the two middle tracks and is cantilevered out over the adjacent tracks, the chutes for the two outer tracks being carried by a steel bridge. The coal elevator tower, conveyor bridge and conveyor house above the bin are of steel construction, sheathed with asbestos-covered corrugated iron. Coal is delivered in hopper bottom cars set out on a stub having capacity for ten loaded cars above the track hoppers and ten empties below them. As this track has a grade of 1 per cent descending to the main line, the cars can be fed to the hoppers by gravity. A derailing switch set normally for a diversion track protects the main line against runaway cars.

Two track hoppers serve two coal elevators, each of which has a 2½-ton skip and individual hoisting machinery. In general one elevator is kept for reserve. The elevators operate automatically when started and each has a capacity of 75 tons of run-of-mine coal per hour, while the machinery is designed to handle lumps as large as 2-ft. cubes. Both skips discharge into a single hopper at the top of the tower, from which the coal is fed to an inclined rubber belt conveyor discharging above the center of the bin, so that the coal is self trimming. The belt has a handling capacity equal to the total of both ships. With this equipment a 24-hour supply of coal can be delivered to the bin during one 8-hour day shift.

Sand is dumped from hopper cars into a track hopper on the down grade side of the coal hoppers and is raised by a bucket-belt elevator to a belt conveyor which delivers it to a bin having capacity for forty carloads, or 2,000 tons. From the bin the sand is delivered manually to a bucket-belt elevator for delivery to hoppers which feed the drying stoves. The dry sand passes by gravity over inclined screens to a hopper-bottom bin and thence to the boot of another belt-bucket elevator, which in turn feeds a belt conveyor running to two storage bins in the top of the coal bin. Each bin has a capacity of 225 cu.ft. and from it there is a gravity feed through 6- and 4-in. pipes to 4-in. swinging chutes which serve three tracks.

Water is taken from the Ohio River, which flows beside the railway. It requires treatment to make it fit for use in boilers, as it is very hard in dry seasons, and in flood time carries a large amount of matter in suspension. An attempt was made to get a supply by sinking wells to a gravel stratum below the river bed, but the water contains too much salt.

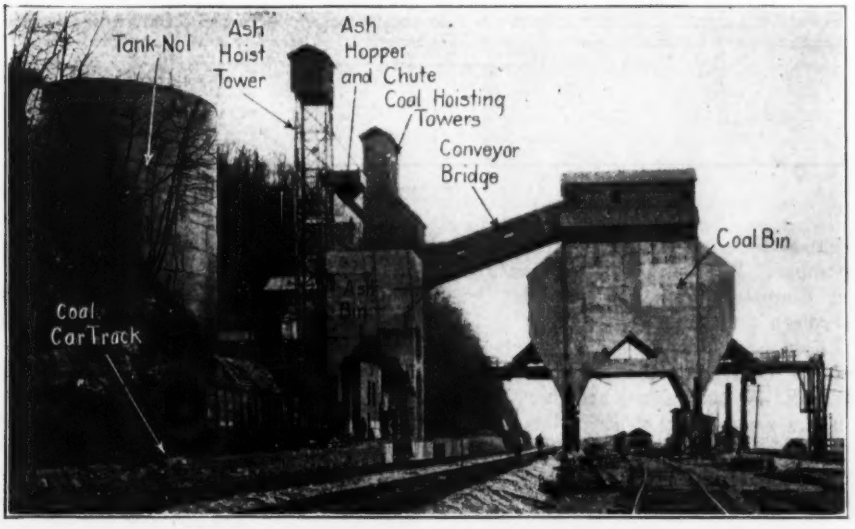


FIG. 1. COAL AND WATER STATION SERVES TRAINS ON SIX TRACKS

Intermittent treatment was adopted, as continuous plant supplying one storage tank would not give sufficient time for sedimentation. Two steel tanks or standpipes, of 400,000 gals. capacity each, are used alternately. As the raw water enters the tank it is dosed at the inlet pipe with a soda-ash and lime solution. To determine the quality of both raw and treated water, a few simple titration tests are made daily by the pumper, using standard solutions of soap, of soda and of acid. The amount of soda and lime required for each tank is determined by the tests of the raw water and by standard tables supplied to the pumper

by the railway company's chemist. Tests of the treated water indicate the efficiency of the treatment.

With this size of tank and an 8-hour pumping period about 16 hours are allowed for chemical reaction and subsequent sedimentation before the water is required for use. At the beginning of the next pumping period, the operator changes six valves, diverting the raw water and solution to the empty tank and connecting the full tank to the 16-in. supply main to the 12-in. water columns. Quick-acting gate valves are operated by levers attached to the stems. As the sets of valves are in proper position when the three levers for one tank are up and the other three are down, there is little chance for mistake or confusion on the part of the pumper. Inlet and outlet pipes are 10-in. and 16-in. in diameter respectively while the solution is fed through a 1½ in pipe.

Four water columns are installed, one for each outside or passenger track and one for each pair of freight tracks. As the ashpits are short, all engines are spotted in the same position, in order that the water columns can be so located that the firemen can fill the tender tanks while the hostlers are cleaning the ashes from the fireboxes.

Investigation showed the economy of a large pumping plant with which one pumper working 8 hr. could pump and treat water sufficient for a day's supply, as compared with a smaller plant requiring three men for three hour shifts. Two triplex pumps were available and together could deliver 42,000 gals. per hour, so that one man on an 8-hour shift could easily supply 300,000 gals, which is in excess of the present maximum daily consumption. At the present wage scale, the annual salary of a pumper exceeds the interest on $25,000 at 5 per cent, so that the use of a plant requiring one man instead of three was equivalent to saving $50,000 in capital expense.

Locomotives on the four freight tracks drop ashes into hoppers having bottom gates over a transverse tunnel in which an electric car runs. When this car is loaded it is run to the end of the tunnel and dumps the ashes into the bucket of a hoisting tower near the coal elevator. From the tower the ashes are spouted to a concrete bin over the coal car track, so that empty coal cars can be loaded with ashes. Each round trip of the ash hoist is started by pressing a button in the tunnel, the car and skip mechanism being interlocked to prevent interference. One man for each shift can handle the removal of ashes even with twelve locomotives per hour. Other ash plants on this road require two men per shift. With the present wage scale capitalized as explained above in regard to the pumpers there is a capital saving of $75,000 by eliminating three men.

At the river end of the ash tunnel is a pump room for the water supply plant, containing two electrically driven pumps with a capacity of 350 gal. per minute. Although this room has been submerged during high-water periods, the operation of the plant has not been affected, as the tunnel concrete was made waterproof in order to provide against this contingency. A 1 : 2½ : 4½ gravel concrete was used, the cement having lime paste added in the proportion of 8 per cent of its volume. A coating of coal tar pitch was applied to the exterior of the walls and roof.

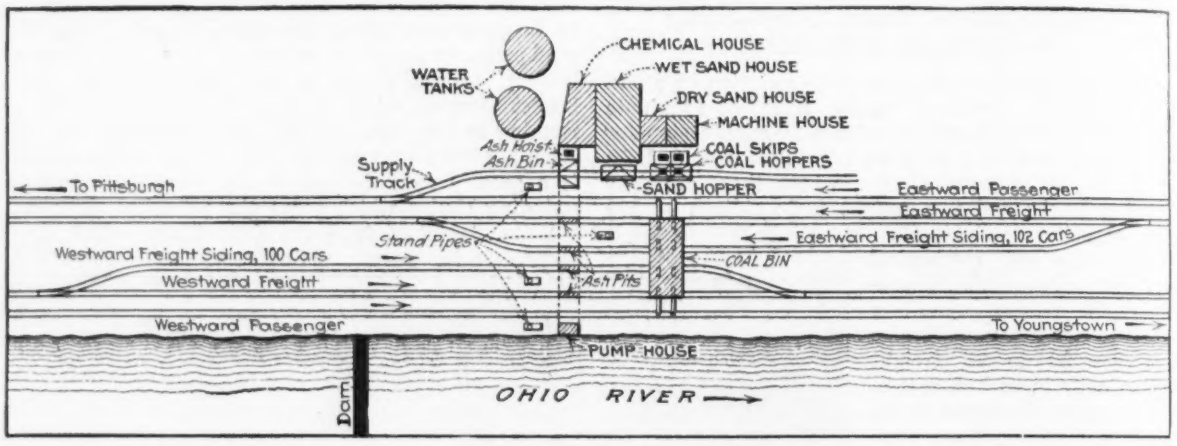


FIG. 2. LAYOUT OF BRIGHTWOOD COAL AND WATER STATION, P. & L. E. R.R.

Electric current for power and light is furnished from the railway company's power plant at McKees Rocks, four miles distant, the combined load representing about 200 hp. Negotiations were opened with a local electric company, but as no allowance could be secured for the short working periods of the motors the minimum change was prohibitive. An alternating current line for signal purposes was being constructed at that time by the railway and three additional wires were installed to carry the 6,600-volt current for the coaling station. It is estimated that the saving over the charge for outside supply will pay in three years for the 4-mile power lines and the transformers, while there will be equal reliability of service.

Comfort and safety of the men have been given attention. Clearances are ample, stairs and walks have guard railings and protection is afforded against falling counterweights at the chutes in case of breakage of their chains or cables.

The design and construction of the plant were under the direction of the late J. A. Atwood and his successor, A. R. Raymer, chief engineer of the Pittsburgh & Lake Erie R.R. The general contractors were Pihl & Miller, Pittsburgh, Pa., and R. H. Beaumont & Co., Philadelphia, Pa., had the contract for the machinery equipment.

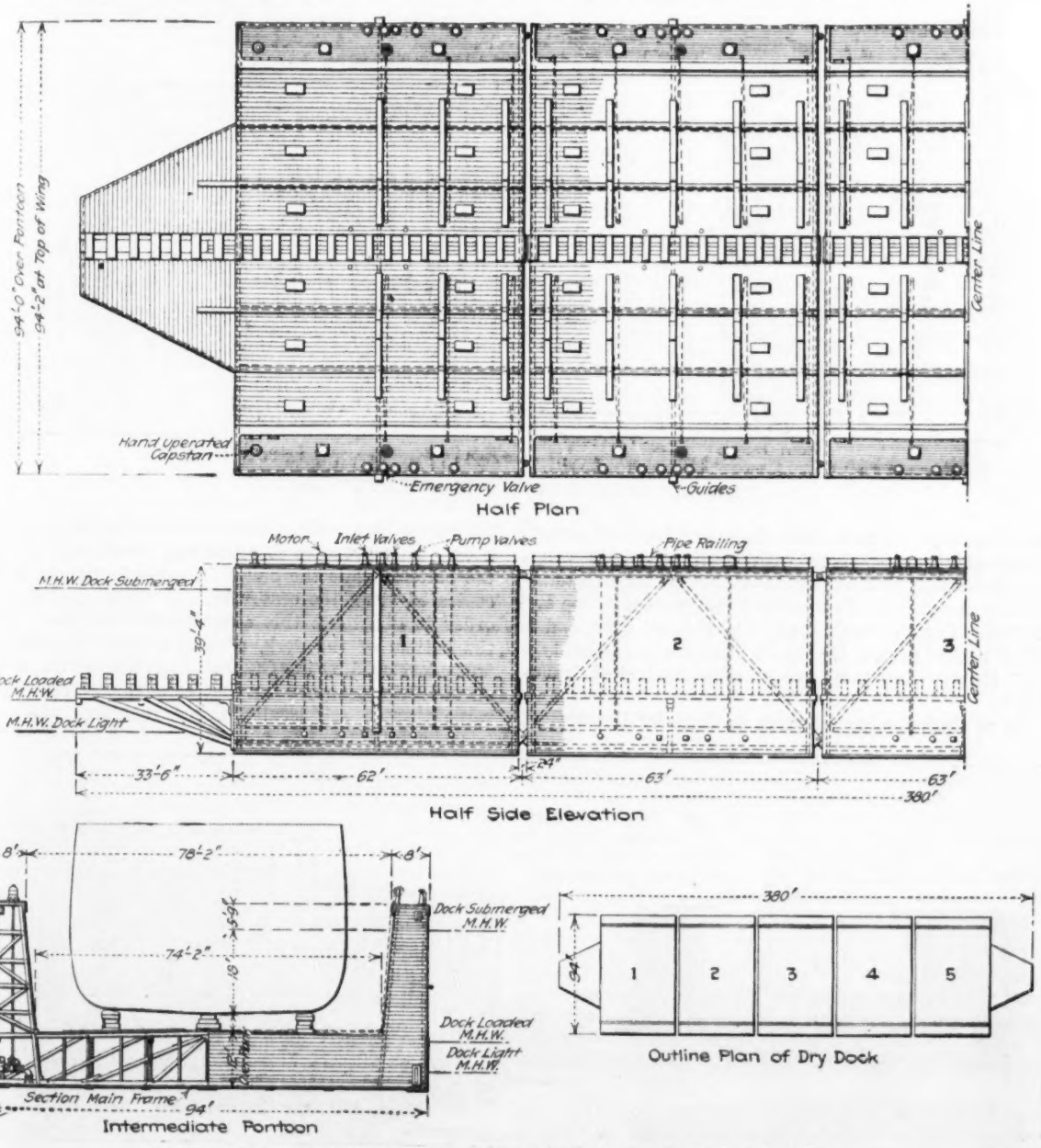
Sectional Floating Drydock Made Continuous by Interlocks

Timber Structure at Pensacola Has Longitudinal Truss System in Wing Walls of Each of Five Sections

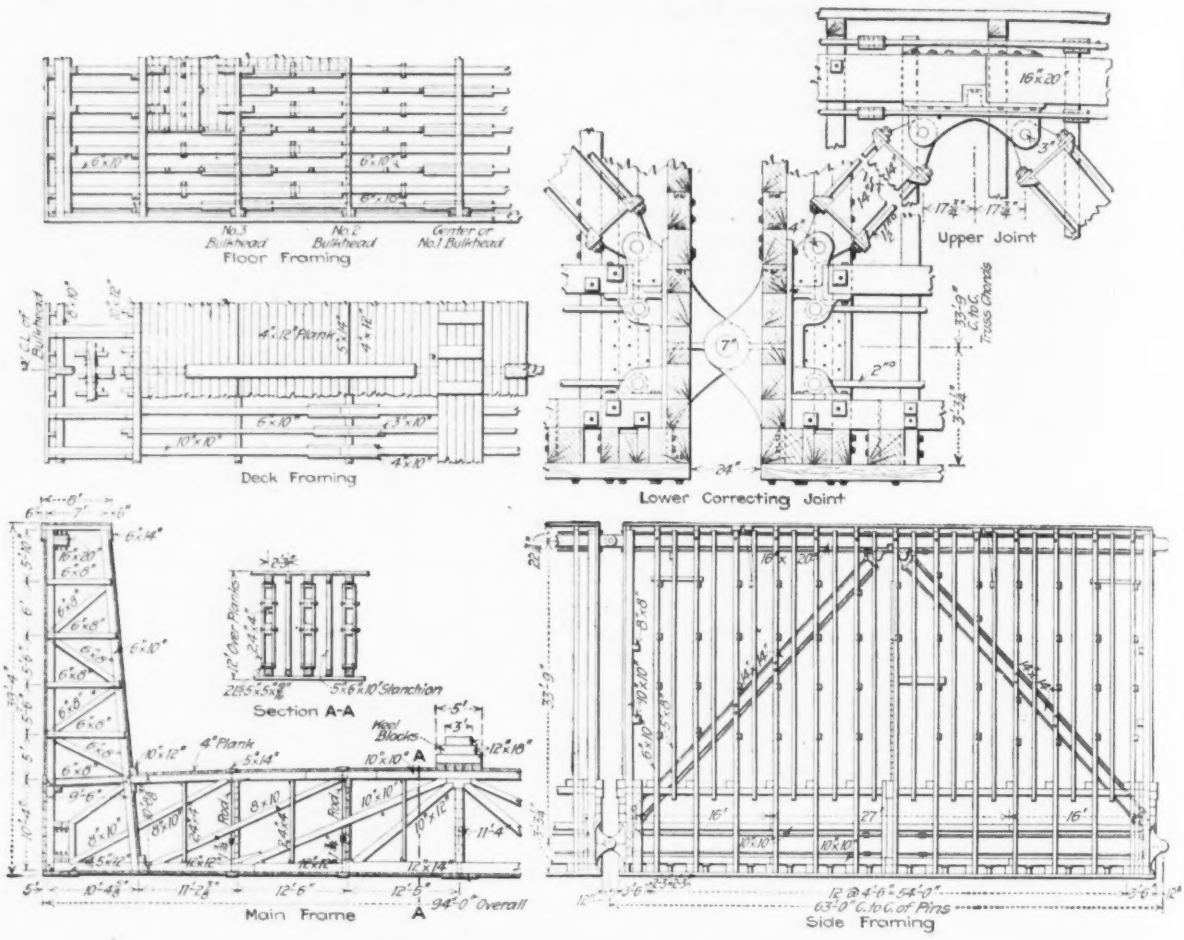
FLOATING dry docks, mostly of from 5,000- to 10,000-ton capacity have been built in a number of ports in this country since the war increase in shipping has made repair facilities imperative. Among them is the recently completed dock for the Bruce Dry Dock Co., at Pensacola, Fla., which was built by the Aberthaw Construction Co. of Boston, Mass., after designs by the Crandall Engineering Co. of East Boston, Mass. Some of the details of the structural designs of this dock are worthy matters for record. Of particular interest are the interlocking connections whereby the longitudinal trusses of the wing walls of each of the five timber sections are made continuous for the length of the structure.

The dock is built of timber throughout and is designed for a normal lifting capacity of 5,000 tons. It is, however, capable of handling a maximum load up to 6,000 tons, for each of the five sections has a reserve buoyancy of 1,200 tons, with the deck practically awash. It has a length overall of 380 ft., an extreme width of 94 ft., with a width of 78 ft. 2 in. between the wings at top and 74 ft. 2 in. at deck level. The pontoons are 12 ft. deep, and can be submerged to give 18 ft. of water over the top of the 42 in. keel blocks.

For the handling of large ships floating drydocks are generally of the sectional type, in which any one section, by turning through 90° can be docked in the remaining sections and thus painted or repaired. There



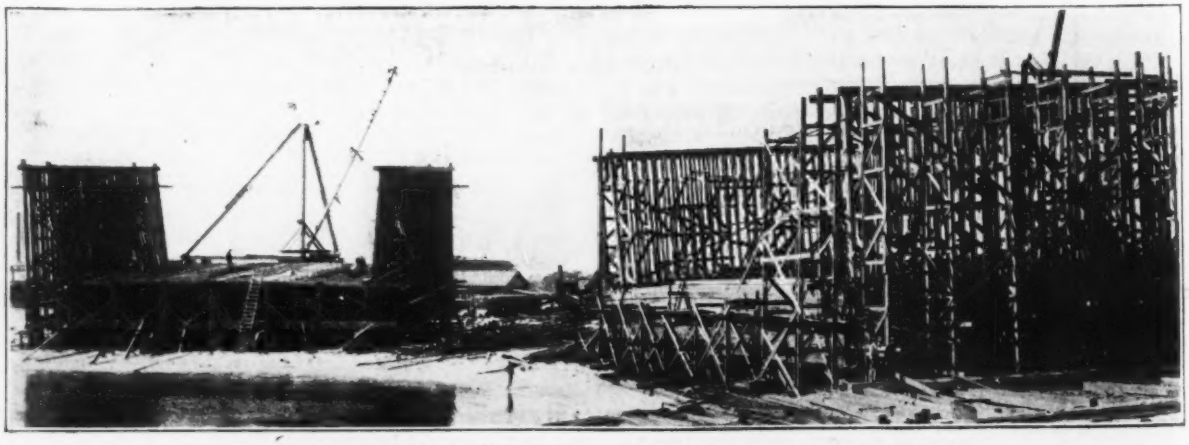
GENERAL LAYOUT OF FLOATING 5,000-TON DRY DOCK AT PENSACOLA, FLA.



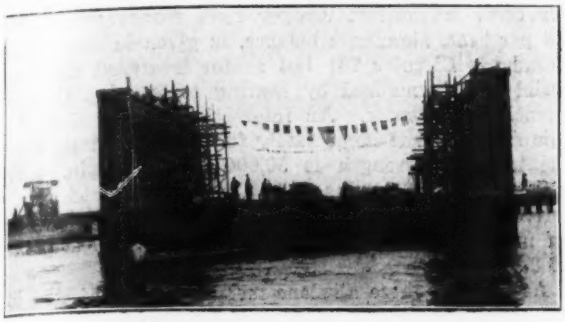
DETAILS OF FRAMING OF PENSACOLA DRY DOCK

are three types of such docks, those consisting of several independent units, those with continuous side wings and those built as a sectional dock but with longitudinal trusses as a means of connecting the sections at top and bottom. The Pensacola dock is of the last type, and is of all timber design, though in some docks of this type the side or wing walls are of structural steel framework.

In raising a ship, the work is done by the upward pressure of buoyancy of the water, on the bottom of the dock. This pressure is uniformly distributed all over the bottom, while the bulk of the ship's weight is concentrated along the center line on the keel blocks. In order to distribute this concentrated load evenly over the bottom of the dock, a special form of transverse truss developed by the Crandall Engineering Co. is used on all docks designed by that company. These transverse trusses are located every few feet along the



TWO OF THE SECTIONS OF DRY DOCK UNDER CONSTRUCTION



ONE OF THE SECTIONS JUST AFTER LAUNCHING

length of the dock. This truss design is a simple, statically determinate type of such form that the stresses in the various members may be accurately calculated.

The design of the dock is such that when the U-shaped sections are connected together they form a rigid unit which will support the weight of the ship without distortion either of the ship or the dock. This is accomplished by the system of longitudinal trusses. In each wing wall of a section there is incorporated the panel of a longitudinal truss. When the sections are joined, by means of the steel castings, these panels are formed into one truss extending along each wing wall of the dock. A set of continuous timbers runs along the upper outer edge of each wing wall. At the center, where the two 31-ft. timbers are spliced, is a cast-steel member with bearings for two 4-in. steel pins. These are the connecting points for the diagonals running from the center top to the two lower corners of the section. These diagonals, 39 ft. long, are attached at the lower end, also by means of a 4-in. steel pin, to a large steel casting forming the point of junction between the one section of the dock and the next. Between the castings at the ends are steel tie rods, consisting of eye-bars, fitted with turnbuckles, for taking tensile stress, and timbers to take the compression load.

The connections between sections are made by means of 7 in. steel pins, top and bottom, let into the heavy cast-steel members, as shown in the drawings herewith. The casting at the bottom corner measures more than 6 ft. vertically and more than 4 ft. in the direction of length of the dock wall. Its width in the other direction is almost 4 ft. This casting transmits the tension or compression from the bottom chord and diagonals and the shear from the diagonals. The casting at the upper part of the dock is much more simple, having only the function of transmitting the tension or compression of the top chord.

As the waters where this dock is to be used are heavily infested with teredos, protection against damage is necessary. Consequently each section will be sheathed over the entire bottom and each of the sides to above the load water line, with two complete layers of sheathing. Each layer consists of felt put on with a coating of tar and covered with a double thickness of creosoted boards, fastened with galvanized nails. This sheathing will cover the timber construction of the dock, which consists mainly of long-leaf yellow pine.

Control of the flotation of the dock is accomplished by means of vertical centrifugal pumps placed in the bottom of the several sections. There is one pump to each of the four transverse compartments in each section. Each pump is driven by its own electric motor, located at the top of the side wall, and connected with the pump by a long shaft. The center of suction opening is 40 in. above the bottom of the dock. The pump and motor capacity have been made sufficient to raise the dock, with load of five thousand tons in 45 min. of continuous pumping.

The twenty motors operating the pumps are each of 20 hp. operating on three-phase, sixty-cycle current at 850 r.p.m. They are direct connected to the pump shafts, and take current at 220 volts. The twenty pumps are 10 in. centrifugal single suction pumps of the closed impeller type. The operation of the dock will be controlled by a dockmaster stationed at the pier at the head of the dock. The pump motors will be controlled from a single switch house near the dockmaster's station.

Road Oils and Carpet Coats

Abstract of a Paper Read by J. A. Duchastel Before the Canadian Good Roads Congress at Winnipeg, Manitoba

THAT the scarcity and inefficiency of labor and the general high cost of materials used in road construction, as well as the difficulty encountered in securing them, have so affected road construction programs that the highway engineer is face to face with a problem that demands not only the strictest economy, but the employment of every resource in preserving existing mileage, was the gist of a paper read by J. A. Duchastel, city engineer and manager, Outremont, Quebec, before the recent annual good roads congress given under the joint auspices of the Manitoba Good Roads Association and the Canadian Good Roads Association at Winnipeg.

Mr. Duchastel asserted that "the greatest of all problems in road construction today, after drainage, is road maintenance." He said that road maintenance should begin the day a new surface has been completed and that only through the most careful study of maintenance requirements could existing mileage be preserved. Following are some of the most pertinent of the points in Mr. Duchastel's paper:

While it is admitted that a surface treatment with bituminous material is a ready means of salvaging many types of pavement, on the other hand, it must be remembered that the road to be treated must have a foundation of sufficient strength to sustain the traffic that it is going to have; that the drainage must be good; and that the road surface must be in good condition. No surface coat will last if these conditions are lacking.

The surface treatment must be considered as a preservative in the same way as a carpet over a hardwood floor; the carpet coat has to be renewed from time to time in the same manner as the carpet over a wooden floor.

Dust-laying oils of asphaltic or tar origin do not, as a general rule, form a protective coat as the heavier oils used in connection with carpet coating. In many cases, far from protecting the surface of the road, these light oils have introduced an element of lubrication in the upper layers of the road surface with the result that disintegration often sets in faster than it would normally.

A sure indication of wear on a road is the presence of dust, and a bituminous carpet coat properly laid will stop the appearance of dust and will preserve the road both from wear and from disintegration due to the presence of water. It will render the road practically impervious. Bituminous materials used for a carpet coat should be asphaltic oil containing from 60 to 80 per cent asphalt or refined tars containing few or no constituents distilling at a temperature of

300 deg. F. Care should be taken to avoid building too thick a carpet, results of which are a rolling or waving in the surface.

In determining whether an old macadam or gravel road should receive a surface treatment, a traffic census should be taken and if it is found that more than 200 automobiles travel over this road per day treatment with a bituminous coat becomes imperative. If the road is in good shape and the coating properly applied, this road can stand up to 2,000 or 3,000 automobiles per day during the summer season.

Before determining whether it is wise to apply a bituminous carpet coat to a macadam or gravel road, it is necessary to investigate the following points:

1. The nature and volume of the traffic over the road.
2. The thickness of the metal composing the roadway itself.
3. The nature of the subsoil and its drainage.

If any of these items require attention it would be a waste of money to treat a surface without remedying any of these faults.

In laying a carpet it is necessary that the road surface be swept clean, so that it resembles a mosaic after the sweeping is done, all stones being exposed over the entire area.

No road oiling should be undertaken unless the roadway is absolutely dry. A couple of hours after the application of the bitumen the surface should be covered with sufficient coarse sand or screenings to absorb all the excess bitumen.

In the case of bleeding of finished surface an application of coarse sand or screening should be made without delay.

Tests of Metal Struts and Beams for Airplanes

STRUCTURAL engineers accustomed to working with metal ⅛-in. thick as a minimum may have cause for mental readjustment before dipping into a field where the thickness of strut and beam webs is measured in terms of one or two hundredths of an inch. And yet analysis of the strength of the built-up members of the all-metal airplane, through study of the significance of tests to failure of a multitude of successive patterns for the struts and frames of the wing framework, throws light on the fundamentals of efficient structural design. Data for such study are given by Major J. S. Nicholson, in the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland for February, 1920, traces the "Development of Metal Construction in Aircraft" in England during and after the war.

Aside from the greater durability and reliability of metal wing framework over the standard designs in spruce, the complete wings developed greater strength under test, though held to the dimensions and weight limits of the wooden types. The two metals utilized were duralumin and cold-rolled alloy steel or plain carbon steel of the following typical properties:

Material	Specific Gravity	Modulus of Elasticity	Yield Point Tension	Ult. Str. Tension	Elong.
Duralumin	2.8	10,750,000	32,500*	58,000*	Not given
Alloy strip	7.8	29,000,000	135,000*	156,000*	15.0%
Carbon strip	7.8	29,000,000	106,400	120,000	4.0%
Spruce	0.45	1,600,000	Max. fibre stress 5,500		

*Heat treated.

The plain carbon steel contained 0.30 per cent carbon and 0.85 per cent manganese and had been annealed when 0.064 in. thick, being then cold rolled to 0.024 in., normalised by heating to 350 deg. C. and cold rolled to 0.018 in. The alloy steel analysed 0.20 per cent carbon, 1.0 per cent chromium, 3.5 per cent nickel, 0.10 per cent vanadium, and had been quenched at 800 deg. C. and drawn at 400 deg. C. after cold rolling. The duralumin analysis is not given (Copper 3.5 to 5.5 per cent, magnesium 0.5 per cent, manganese 0.5 to 0.8 per cent, aluminum balance, is given in Bureau of Standards Circular 76) but as for treatment the material was normalized by heating to 500 deg. C. and quenching in water. An interesting characteristic of this metal is that immediately following this treatment the ultimate strength is 50,000 lbs. per sq.in. with yield point of 20,000 lbs. per sq.in., both of which properties undergo an increase during the next ten days to an ultimate strength of 60,000 lbs. and a yield point of 34,000 lbs.

As most of these airplane members are subjected to combined compressive and bending stresses, the differing properties of steel and duralumin offset each other strikingly. The modulus of elasticity of duralumin is only 0.37 that of steel, but for a design of the same weight and overall dimensions, the moment of inertia is 2.78 that of steel—hence the *EI* factor for duralumin will be $0.37 \times 2.78 = 1.03$ that of steel. The beams or struts of the two materials should therefore be equally strong, but the duralumin has the important advantage of superior rigidity against secondary failure, in that its individual components will have 2.78 times the thickness of the corresponding steel components. Most of the strut and beam designs suggested for test broke down by such secondary failure at low fiber stresses.

The tests of the members give ample proof of the importance of makeup and detailing in reaching high efficiencies in these tiny members. The best designs executed in steel attained unit fiber strengths as high as 112,000 lb. per sq.in. in combined compression and bending. One design that reached 123,000 lbs. fiber stress was further increased to develop 175,000 lb. by special heat treatment after construction. The duralumin spars showed strengths of about 40,000 lb. per sq.in.

Comparison of Results of Water Analyses and Surveys

In checking over the results of a recent survey of railroad water supplies in Iowa the following figures were obtained as to the agreement between the examination made in accordance with the United States Treasury Department method and the sanitary survey made by an experienced officer of the United States Public Health Service.

WATER SUPPLIES IN IOWA

Supplies Satisfactory	Supplies Unsatisfactory		
By Both Survey and Examination	By Both Survey and Analysis	By Survey, Analysis Satisfactory	By Analysis, Survey Satisfactory
67%	18%	9%	6%

More significant than this has been the work by the Division of Sanitation, Minnesota State Board of Health, since the Minnesota work covers a longer period and includes the results upon a much larger number of supplies. The results given in the following table of unsatisfactory supplies were based on the investigation of 1,119 water supplies of which 730 were found to be unsatisfactory in their existing condition.

UNSATISFACTORY WATER SUPPLIES IN MINNESOTA, 1912-18

Unsatisfactory Water Supplies	Shown Unsatisfactory by: Field Survey and Analysis	Field Survey	Analytical Results
Number 730	354	338	38
Per cent, 100	49	46	5

From 1920 report of Committee on Official Standards of Water Analysis, American Water Works Association, Jack Hinman, Jr., Chairman, Iowa City, Iowa.

Developments in Railway Water-Supply Service

Electric Motors and Oil Engines for Centrifugal Pumps—Storage Capacity and Tanks—Treatment of Water

INCREASED use of electric pumping plants for railway service has resulted from the increasing number of points at which current is available and from the economy of electric operation, especially when the motors are under automatic control or remote control (as by a push button in the station agent's office) so as to eliminate the expense of continual attendance. This statement was made by C. R. Knowles, superintendent of water service of the Illinois Central R.R., in a paper read recently before the Western Society of Engineers. On this railway there have been installed duplicate electric units, each half of the unit having a daily capacity of 1,000,000 gal. and the operation being controlled entirely by the height of water in the tanks. The cost for current is about the same as the former cost of coal, but the electric plant requires only one man as against three men for the steam plant, so that there is a net saving of $1,500 per year for labor.

Oil engines of the semi-diesel type are being used extensively for railway pumping stations and are proving economical, besides being practically as reliable as steam plants. They are especially adapted for driving centrifugal pumps but are not as flexible as steam engines when used with positive displacement pumps. Mr. Knowles states that failure to recognize this latter point has resulted in some unsatisfactory installations. The substitution of two oil engines for a steam plant eliminated two pump men, with an annual saving of $1,800 for labor besides a reduction in cost of fuel. Increased use of centrifugal pumps has resulted from the introduction of oil engines and electric motors. Gasoline engines were never serious competitors of steam, says Mr. Knowles, except at the smaller pumping stations and at other points where the cost of coal was excessive.

Water Storage and Tanks

Greater storage capacity at water stations has become an economic necessity under present conditions of shorter hours, higher wages and overtime pay. With constant delivery from a city supply and with a fairly uniform demand, the size of tank is not important. But where the delivery and demand are irregular, the tank should be of sufficient capacity to take care of maximum consumption during the period when water is not being delivered. If the tank is too small to carry a night supply the cost of water service may be increased materially by the necessity of employing additional pump men. In a number of cases reservoirs have been established to insure an adequate supply for water stations.

Steel tanks had been largely superseding wood tanks until a few years ago, but the high cost and restricted supply of steel during the war necessitated a return to wood. Creosoted wood tanks have proved a profitable investment" says Mr. Knowles, as their first cost is less than that of tanks of steel or untreated wood, their maintenance cost is less and their life is expected to be as long as that of tanks of the best untreated wood. An advantage of steel tanks with conical or hemispherical bottoms is the opportunity for sedimentation. Mr. Knowles suggests the need of a simple settling basin or filter for use with flat-bottom tanks, as the removal of suspended matter from the work will effect material economy in repairing and washing locomotive boilers.

Treatment of Water

Treatment of water for locomotives, generally by a softening process, and the removal of suspended matter and scale-producing elements has received increased attention within the past few years owing to the increasing cost of boiler repairs and fuel and the urgent necessity of keeping locomotives in service. On the Great Northern Ry., 77 water softening plants have been installed under a program carried out by C. H. Koyl, who is now engineer of water service of the Chicago, Milwaukee & St. Paul Ry., and is planning to establish water treating plants in the bad water districts. The Missouri Pacific Ry. in 1918 had 52 water treating plants, mainly in the hard-water district of the plains west of Kansas City. According to a report by R. C. Bardwell, chief chemist, these plants in 1918 treated 1,368,305,000 gal. and removed 1795 tons of scale forming matter at a cost of $89,873, including labor, chemicals, maintenance and 10 per cent for depreciation on an investment of $154,300. The saving for one year in boiler repairs and kindred expenses was nearly double the total investment.

Mr. Knowles states that there are now about 600 railway water treatment plants, treating an average of 36,000,000 gal. each, or a total of 21,600,000,000 gal. annually. Assuming that 8 per cent of the total railway water consumption, or 72,000,000,000 gal., is used by locomotives and power plants and that 50 per cent of this is of such quality that treatment would be economical, the existing plants furnish less than 6 per cent of the amount of treated water needed. That a larger proportion of the water is not treated is thought by Mr. Knowles to be due in part to lack of centralized responsibility for the quality of the water on many roads. In his opinion, few investments in railway improvements will show quicker or larger returns than a properly designed and operated water treating plant. The experience of the Missouri Pacific Ry., noted above, supports this opinion.

New Studies of High Chromium Steel

Experiments on high chromium steel have recently been carried out by the Bureau of Standards to determine the influence of various kinds of heat treatment. Advance notes of the general trend of the results indicate that the maximum hardness is obtained by quenching at about 1,066 deg. C. (1,950 deg. F.), but that quenching from 955 deg. C. (1,750 deg. F.) gives the best combination of strength and ductility. Steel quenched at temperatures above 1,010 deg. C. (1,850 deg. F.) shows a very low elongation and reduction of area. Such brittleness can be decreased by short-time tempering, up to about 427 deg. C. (800 deg. F.), while tempering above this heat decreases the strength and hardness rapidly, the most rapid change being produced in tempering between about 800 and 1,000 deg. F. The material studied had the composition C 0.29 per cent, Mn 0.38 per cent, Si 0.70 per cent, Cr 13.2 per cent. All quenching was done in oil.

First Modern Grain Elevator In Australia

American Equipment and American Engineer Control Construction—Bin Walls Poured to Full Height in Sections—Concrete Chuting System Unique

BUILT entirely with American equipment and under the direction of the American superintendent for an Australian contractor, the first modern terminal grain elevator in Australia is being completed on Glebe Island, Sydney. The structure, with complementary construction, is being built for the New South Wales Government and will provide for the storage of approximately 6,000,000 bu. of wheat. Construction includes the circular storage bins, the working house, a track shed, three cargo sheds, a power control station, a boiler and dryer house, a dust condenser, a dust incinerator, towers and conveyor galleries and miscellaneous construction.

The elevator is being constructed upon the site of an old stone quarry formerly operated by the New South Wales Government. About 250,000 cu.yd. of material were removed from the site prior to the time it was decided upon as the location for the elevator. Excavation of an additional 50,000 cu.yd. was necessary to bring the site to the proper track grade.

Storage is provided in 72 circular bins with inside diameters of 31 ft. 2 in., and 71 interspace bins, affording storage for 5,600,000 bu. The overall width of the bins is 267 ft. 6 in.; their overall length 302 ft. 6 in.; and their height above slab 108 ft. Bin walls are concrete 8 in. thick, of a 1:2½:4 mix, reinforced by steel bars ⅜ x 1¼ in. so as to form a continuous spiral. The usual moving form construction was followed in pouring the bin walls, and the 1½-in. jack-rods, by means of which the forms were raised, were used as vertical reinforcement. Horizontal reinforcing bars were fastened to these jack-rods by means of a special wire clip made of No. 12 standard-gage steel wire. The details of the wire clip, showing the method of fastening to jack-rods and splicing horizontal bars are shown in accompanying sketches. In splicing horizontal reinforcement bars an overlap of 2½ ft. was allowed. The specifications required the ends of the bars to be hooked where splicing was

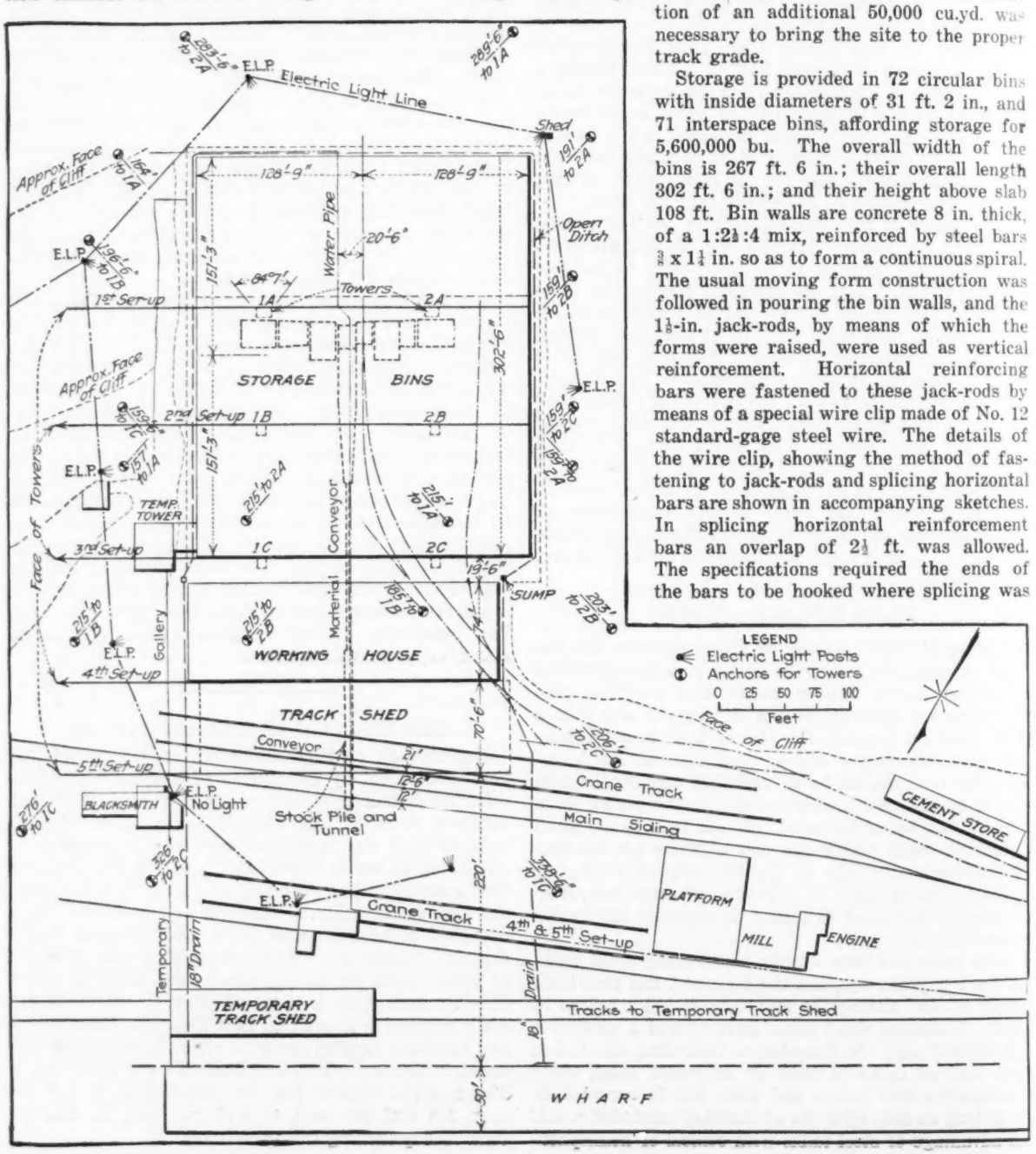


FIG. 1. CONTRACTOR'S LAYOUT INDICATING TOWER ANCHORAGE POINTS AND TOWER SET-UPS

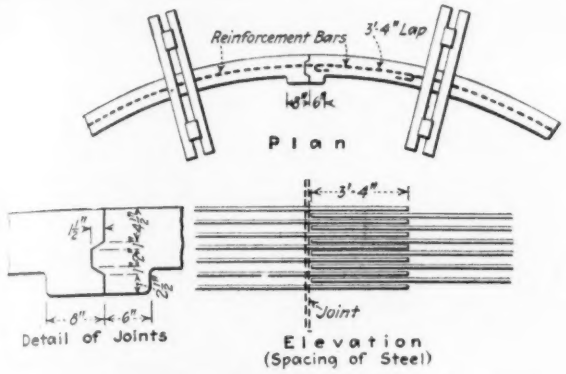


FIG. 4. CONSTRUCTION CUT IN BIN WALLS SHOWS DETAIL OF JOINING SECTIONS

done. The forms were fastened to iron-bark wood pieces 5 x 7 in., generally 7½ ft. in length. They were yoked together with lumber of the same material and width and thickness and bolted with ¾-in. bolts. The form yokes supporting the joists upon which rested the chuting trestles were longer than 7½ ft., elevated to give ample clearance between chuting trestle and decking floor. Sheeting for the forms were of jarrah, an Australian hardwood, 1½ × 4½ in., 4½ ft. long. All other lumber used on the job was Oregon fir.

The first work on the elevator was done in November, 1918, when a temporary siding for the storage of materials was laid. Rock excavation began about the same time and early in March, 1919, part of the contractor's plant—all of it American — was installed. Work on the construction of the twin concreting towers began in April, 1919. Both of the towers were built upon the ground and raised by a fleet of donkey engines, additional pulling power being furnished by two railroad freight engines located at the waterfront several hundred feet distant. Concreting towers were held in place by ⅝-in. steel cables fastened to eye-bars concreted in rock. A predetermined set of anchorage points was indicated upon the contractor's layout for each tower for each set-up. In raising the towers considerable advantage was had in the fact that the foot of the tower rested against the base of a cliff, and the difficulty in erection was modified because of the position of the main supporting lines on the cliff's top. In anchoring the towers four lines of ⅝-in. steel cable were set at vertical intervals of 42 ft., making four sets of four lines each for each tower. Towers were of a six-leg type, the front posts of the main bay being of 6 x 8-in. material, the back posts 6 x 6-in. pieces and the outside posts 5 in. square. Posts were braced horizontally with 2 x 10-in. planks and diagonally with 2 x 6-in. pieces. One of the towers was equipped with a passenger elevator to carry workmen to and from bin wall tops.

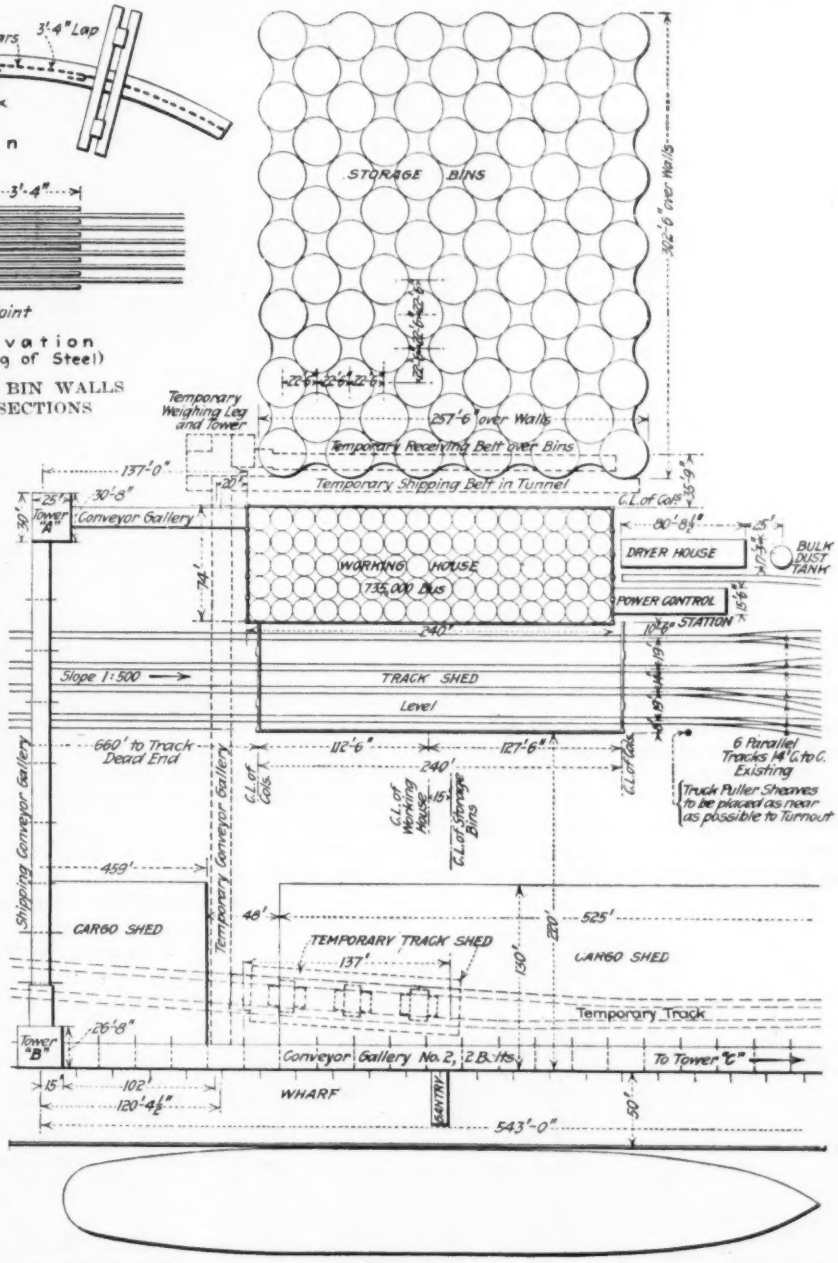


FIG. 2. GENERAL PLAN OF STORAGE BINS, WORKING HOUSE STORAGE SHEDS, TERMINAL FACILITIES

Because of the high cost of lumber necessary in the construction of forms it was found impossible to proceed with the erection of all bins simultaneously. Concrete was therefore poured on but one section at a time —each of three sections containing an area about 100 ft. wide and having for length the full width of the bins

or 267½ ft. Such a construction method necessitated making a vertical joint through piers, slab and bin walls. The joint was made through the centers of the circular bins. Horizontal reinforcement was made to project beyond the joint so that when a bond had been effected with the adjacent section an overlap of horizontal reinforcement of 3 ft. 4 in. was had. Reinforcement on the second section was spaced midway between bars in the first section and that in the first and third section were therefore in the same plane. A 3-in. off-set was given to the bin wall extending 7 in. each side of the joint and on the inside of the circular wall, giving a thickness of 11 in. A groove, 1½ in. deep, 2 in. wide and with 1-in. shoulders, was made in the section first poured and ran the entire height of bin walls 4½ in. from the convex surface.

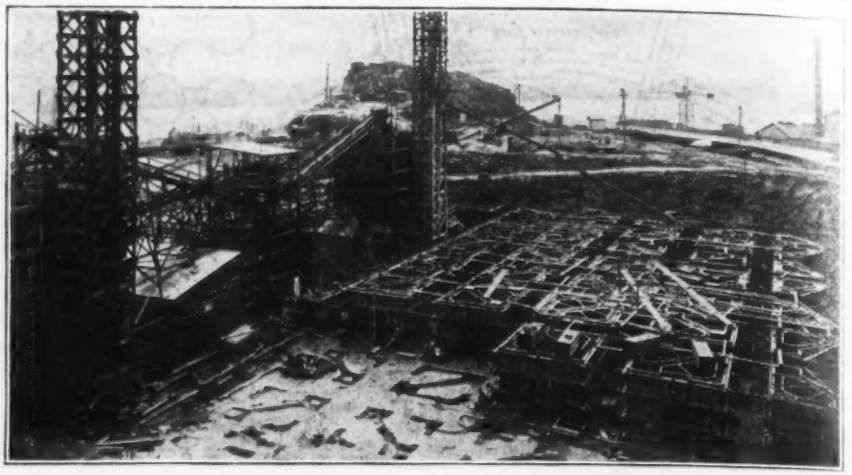


FIG. 1a. PIER FORMS AND FOOTING EXCAVATION, FIRST SECTION OF BIN WALLS

The elevator site being a former stone quarry a solid rock foundation was had upon which to support the loading of 25 tons per square foot for the storage bins and 30 tons per square foot for the working house. This loading was distributed by a reinforced-concrete slab 12 in. thick under interspace bins and 14 in. thick under circular bins. Piers and slab were so constructed to make each bin self emptying. Concreting on the piers of the first section began the latter part of May, 1919, and on the bin walls July 21. By August 9—or a total elapsed time of 38.83 ten-hour shifts—the first section had been poured to its full height of 108 ft.

In order to begin work on the second section of the bin walls, it was necessary to move both material bins and concreting towers back from the face of the completed section approximately 100 ft. Material conveyors, bins and sheds were moved in a day and the first tower was moved its approximate 100 ft. in three hours. Hoists, used in handling concreting materials on the job, also were used in moving the material bins and the concrete towers and in conveying machinery. Material bins and the concreting tower were lashed and bolted together, set upon rollers and with the four sets of supporting cables held taut moved back to new sets of anchorage points. Three such set-ups were necessary to complete the bin walls. By the end of January, 1920, all work had been completed on the storage bin walls with the exception of the roof and the conveyor galleries and work had commenced on the circular bin forms for the working house.

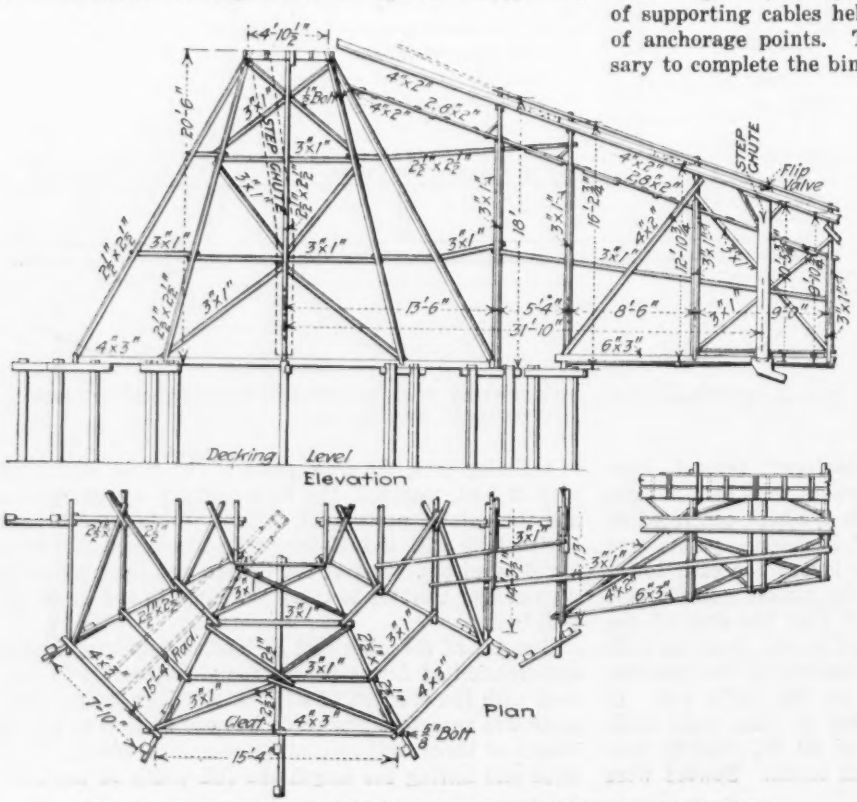


FIG. 3. PLAN AND ELEVATION OF FIXED TOWER TRESTLE USED IN CONCRETE DISTRIBUTION

One of the features of the construction was the type of chuting, designed and erected by the contractor, used in handling concrete from towers to bin walls. Two octagonal timber trestle towers were built, resting upon the moving form yokes. These towers were so set that each served the same number of bins, and in the approximate centers of each half section being poured. The construction of each half section was, therefore, a complete job, as each tower was served by its own mixer and concreting tower. The circular towers had a top diameter of 5 ft., bottom diameter of 29 ft. and a height of 20½ ft. Legs were

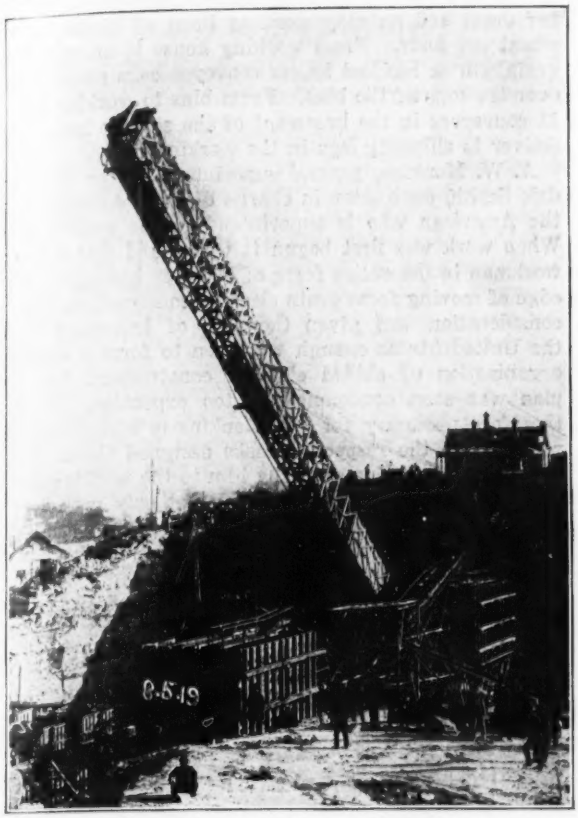


FIG. 2a. FIRST OF TWIN 210-FT. CONCRETING TOWERS RAISED IN 50 MINUTES

built of 2½ x 2½-in. lumber, fastened together by cleats of the same dimensions and braced with 1 x 3-in. braces. The bottom timbers were of 3 x 4-in. material and the top timbers of 2 x 6-in. material. The top was decked with 1 x 6-in. flooring laid upon 2 x 4-in. joists. It was surrounded by a handrail and built up in the center was a frame supporting a turnhead of 12-gage sheet iron, 2 ft. inside diameter. The turnhead at its mouth tapered to a diameter of 9 in., and, fitted with an elbow, delivered concrete to the series of chutes extending radially from it to the centers of all bins whose walls the turnhead served. For pouring concrete on bin walls immediately beneath the circular trestle tower step chutes, fitted with flipvalves, were used. Despite the apparent fragility of these trestle towers they were found entirely adequate to handle all concrete. Only 6,000 ft., b.m., were used in the construction of each tower. Chuting used, with the exception of that in the terminal spouts, was of No. 12 standard-gage sheet-iron and of the deep cross-section shown in an accompanying sketch. Chuting in the terminal spouts was No. 22 gage. All chuting, however, was of the same deep cross-section.

In pouring the concrete on the bin walls some rather unusual work was done. Progress reports and bin-wall alignment records were kept on each of the three sections and the data secured showed that, during the pouring of the first section an average of 5.4 ft. every two 10-hr. shifts was maintained. On the first section the hoppers

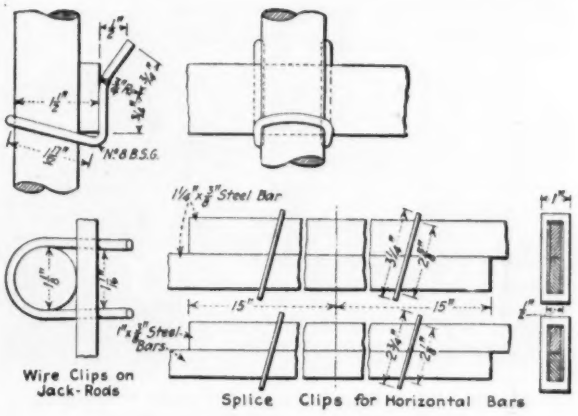


FIG. 6. CLIPS USED FOR SPLICING BIN-WALL REINFORCEMENT

were installed at the same time but it was found to be dangerous, so was discontinued during the pouring of the other two sections. On the second section workmen averaged a total lift of 9.8 ft. per day of two 10-hr. shifts, and on the third section 12 ft. per day was attained. Considerable rain fell during the pouring of the second and third sections, particularly during the pouring of the third section when as much as 1.43 in. was recorded during 24 hr.

The working house will supply temporary storage for 785,000 bu. provided in 80 circular bins of a diameter of 14 ft. 5 in. Bin walls are of 6-in. concrete reinforced with steel bars ⅜ x 1 in., and set 25 ft. above the slab level of the main storage bins. The working house is 77 ft. wide and 242 ft. long, as measured by the slab under the bin walls. Bin walls are spaced in general 15 ft., c. to c. and are 74 ft. in height. The total height of the working house is 185 ft. 9 in. above the base of rail in the track shed. It is joined to the storage bins 19½ ft. distant, by conveyor galleries. Ship-

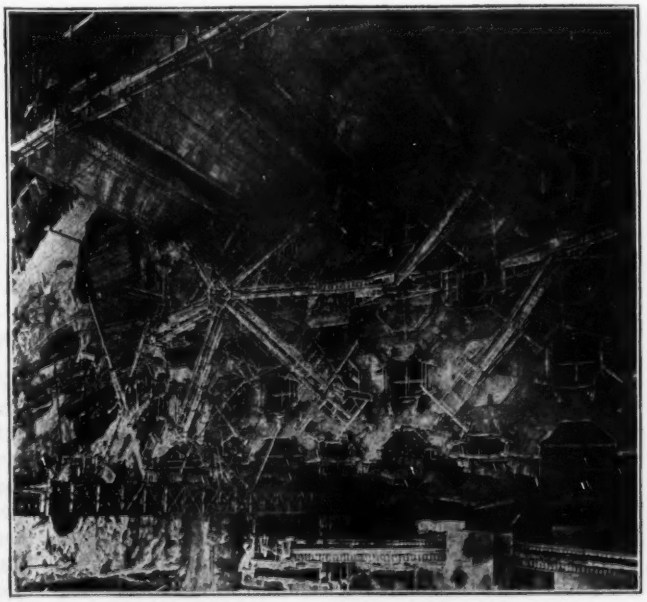


FIG. 4a. PHOTOGRAPH FROM CONCRETING TOWER SHOWS SPIDERWEB CHUTING SYSTEM AND VERTICAL JOINT THROUGH BINS

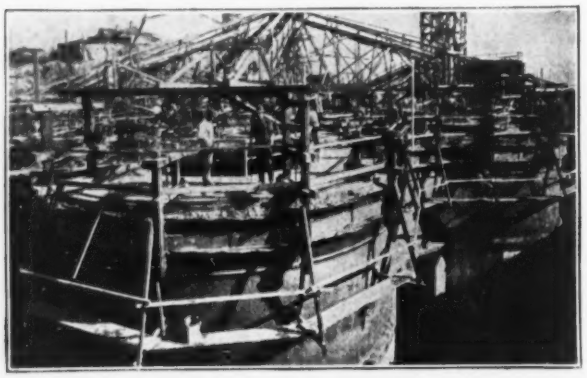


FIG. 5a. LONG FORM YOKES SUPPORT FINISHING SCAFFOLD AND TRUSSED BEAMS OF CHUTING SYSTEM

ping and receiving legs are placed beneath the slab level in the working house and above the bin slab are the conveyor floor, scale floor, weighing floor and the top floor.

When finished, the track shed, where the grain will be received, is to be 240 ft. long and 70½ ft. wide, on center lines of columns, and will extend over four parallel tracks. The track shed is to contain 20 track hoppers, each hopper having a capacity of 2,500 bu. and placed below the base of rail. This part of the plant will be able to care for 30 cars an hour. Grain will be conveyed from the track hoppers to five receiving legs in the working house and then elevated to the top of the structure to garners of 2,500-bu. capacity. Below each garner is to be placed a scale hopper capable of weighing 1,600 bu. of grain at a time. From the scales grain will be distributed by rubber conveyor belts to any part of the working or storage houses.

Initial installation also includes the construction of three cargo sheds, 381 ft., 525 ft., and 459 ft. in length, respectively, and approximately 132 ft. wide. Space is allowed for an increase in this covered storage if necessary. Construction also covers the building of a series of wharves, one of which, 2,600 ft. in length, is practically complete.

Grain to be shipped is withdrawn from any part of the plant to the five shipping legs in the working house whence it will be elevated to the 1,000-bu. garners above automatic shipping scales having a capacity of 4 tons per draft and an easy working limit of 16,000 bu. of wheat per hour. From working house to storage bins grain will be handled by six conveyor belts running out over the tops of the bins. From bins to working house 11 conveyors in the basement of the storage house will deliver to shipping legs in the working house.

A. W. Menkins, general superintendent for H. Teesdale Smith, contractor in charge of the construction, is the American who is superintending the construction. When work was first begun it was found that not one workman in the entire force of 500 men had any knowledge of moving form grain elevator construction. Some consideration was given the plan of importing from the United States enough workmen to form a skeleton organization of skilled elevator constructors, but the plan was soon condemned as too expensive. It was therefore necessary for Mr. Menkins to educate all the workmen in the respective tasks assigned them. Only the highest praise is given by him to the working force which surrounded him and which not only proved efficient but which evinced unusual pride in its work—the construction of the first grain elevator south of the equator.

All of the machinery and equipment used on the job was of American manufacture. The elevator was designed by the John S. Metcalfe Co., a firm which has designed many like structures in the United States and Canada. W. H. Merry is the chief engineer for H. Teesdale Smith. Engineering superintendence and inspection was furnished by Robert Kendall, chief engineer, Railroad and Wheat Silos, New South Wales Government. Detailed plans were furnished by the contractor, approved by the engineer.

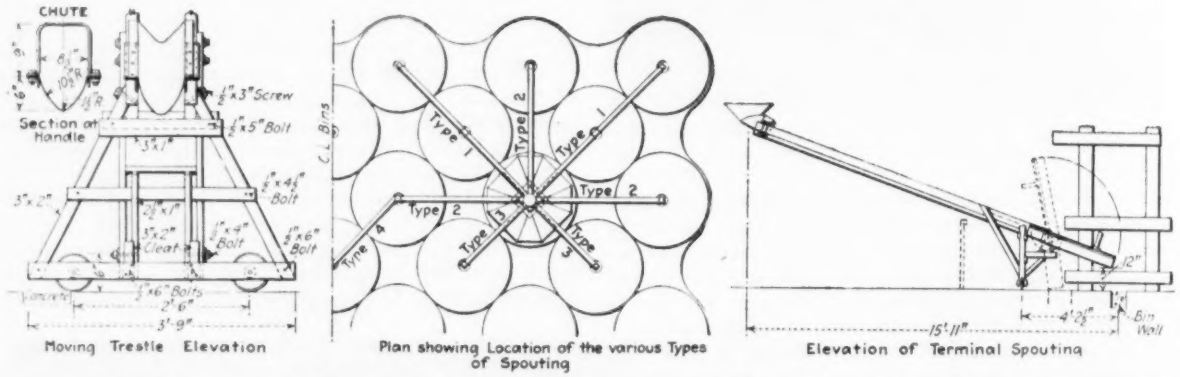


FIG. 5. TERMINAL TIMBER TRESTLE IS OF BICYCLE TYPE—TRUSSED BEAMS OF VARIOUS TYPES IN CONCRETE HANDLING—CHUTE DETAIL SHOWS DEEP CROSS-SECTION

Water Works Association Has Seven Sections

With the completion of the organization of the Canadian Section of the American Water Works Association at Montreal in June, the association now has seven geographical sections. The other six are: New York (including northern New Jersey); Four-State (southern New Jersey, eastern Pennsylvania, Maryland, Delaware, and District of Columbia); Central State (western Pennsylvania, Ohio, Indiana, and Michigan); Illinois; Iowa; Minnesota. Each section has its own chairman, vice-chairman, treasurer, secretary and trustees, and its own constitution.

Distinctive Features of a Co-operative Course in Engineering

Abstract of paper by W. H. Timbie, Associate Professor in Electrical Engineering, Massachusetts Institute of Technology, before Annual Meeting of Society for the Promotion of Engineering Education.

DIFFERENCES in several important respects from similar courses in other institutions are to be found in the co-operative course in electrical engineering conducted by Massachusetts Institute of Technology and the General Electric Co. The course was established primarily to produce men with an intimate knowledge of the best manufacturing processes and a thorough training in modern research methods and, where possible, ability for creative design. The principal distinction of the course is the fact that the single co-operating company recognizes that for three years the students are placed in a plant for the particular purpose of being educated and trained as engineers of a particularly high grade.

The course covers a period of five years, the first two being identical with the regular course in electrical engineering at the Institute and the last three being divided between instruction in theory at the Institute and training in manufacturing methods at the Lynn plant of the General Electric Co. While at the works the students are given a fixed payment per week as employees of the company. Each group of students spends alternately thirteen weeks at the plant and eleven weeks at the Institute, with a vacation period of two weeks at the end of the period at the Institute. The period of thirteen weeks at the shop was determined as the minimum time required for the uninterrupted study necessary for the students to familiarize themselves with all phases of the work in a single department, and the period of eleven weeks at the Institute was determined to fit the standard length of theoretical courses—the shortest being ten weeks and the longest some multiple of ten weeks.

Full recognition by the single co-operating company of the purposes of the course leads to the use of these students not for the purpose of getting out greater immediate production in some departments, but to placing them in the shops and offices to learn and to learn thoroughly manufacturing methods and the best relations of labor, mechanism, and materials in high-grade production. The length of time spent in each department is regulated not by the needs of that department but by the value of the experience to the student. The officials of the company believe that by this method they can produce the future engineers who will be so badly needed by the company and by other industrial concerns in the near future.

Other distinctive features of the course are the continuity of the theoretical studies and humanistic subjects; liberalizing of the engineering student's education by means of collateral reading; the inculcation of an intense spirit of loyalty to the Institute and to the co-operating company; the unusual amount of theoretical work included, and the fact that a Master's Degree is awarded by the Institute upon the completion of the five years' work.

In the study of English a plan is used to promote interest by the reading of letters from successful graduates, bringing out the fact that the higher the engineer rises in his profession, the greater is his need to be able to speak well and to write well. Classes are also formed into committees for the practical presentation of engineering reports. Ready access to books on all subjects and in all fields of literature is afforded and the program of the student is laid out with the definite purpose of giving him an opportunity for reading outside of the prescribed courses.

As an example of the unusual amount of theoretical work included in the course, a student pursues one course after another in mathematical physics from the beginning of his freshman year to the end of his postgraduate year. In the middle of his sophomore year he begins the study of electrical engineering and continues it without a break four terms a year for the remaining three and one-half years. During the last year the work at the institute is composed of advanced research and creative design.

Handling and Sorting New and Old Rails

MORE GENERAL use of mechanical means of handling heavy rails and old rails at railway store yards, together with greater care in sorting old rails for further use, were among the suggestions made by the rail-handling committee at the recent annual meeting of the purchases and stores section of the American Railroad Association. It was considered that economy can be effected by the use of locomotive cranes, rail loaders, ditching machines and steam derrick cars. The committee stated that it is more economical to distribute new rails along the track than to unload them into stockpiles.

Inspection of old rails should be performed by stores department men whose qualifications are satisfactory to the engineering department. They should be classified for main track, for branch lines and for yards and sidings, those of each class being further classified into four divisions according to height measured to $\frac{1}{32}$-in. To distinguish the rails, the committee proposed painting the ends green, white and red for the three main classifications and marking the ends with numbers 1 to 4 in white paint for the four secondary classifications. At the rail docks, each class and subdivision would be piled separately, the rails being in opposite directions in alternate layers, with one end of each layer carefully lined to facilitate counting and measurement. These piles should be as high as they can be built with the machine, and it is suggested that many railways incur considerable unnecessary expense through lack of apparatus for handling rails.

Instead of leaving the disposal of scrap rail to track supervisors it is thought likely that much of this scrap could be resold by the purchasers as second-hand rails. For this reason the committee considers that all rail classed as scrap should be sent to the division or general stores department for inspection and classification.

Paving Stone Production Increases

Manufacturers of granite paving block in the eastern part of the United States, according to the U. S. Geological Survey, report an increase of nearly 40 per cent in quantity, those in Minnesota and Wisconsin report an increase of more than 50 per cent, and those in Missouri report a decrease of 25 per cent during 1919. The entire paving block industry made an estimated increase of 36 per cent in quantity and about $6 an average price per thousand during 1919.

Concrete Elevated-Railway Floor With Precast Form Slabs

Cost of Wood Forms Leads to Devising New Method of Constructing Slab Floor—Results of Tests Show Thorough Bond

A NEW type of solid-floor construction is being applied to a portion of the Webster Ave. extension of the Third Avenue elevated railway in New York City, by the Interborough Rapid Transit Co., which is building the new line. It comprises precast reinforced-concrete "planks" which are laid across the stringers and serve as form or centering, and a cast-in-place top course of concrete, making the total thickness of concrete 6½ in., as shown in Fig. 1. The cast-in-place portion of the slab bonds with the form unit so thoroughly that integral action of the entire slab results. The construction was submitted to careful test before its use for the elevated-railway floor was approved, and these tests gave remarkably satisfactory results.

The Webster Ave. extension leaves the Third Ave. line just north of Fordham Road; it runs along Webster Ave. to Gun Hill Road and through Gun Hill Road to White Plains Road, where it connects with an elevated extension of the subway system. On Webster Ave. the railroad crosses Mosholu Parkway, a broad boulevard which connects Van Cortlandt Park with Bronx Park and is also a link of the main thoroughfare leading out of New York in a northeasterly direction.

On account of the importance of this thoroughfare it was required by the certificate authorizing the construction of the railroad that the portion of the structure crossing Mosholu Parkway should be of an ornamental character. This was interpreted as including that the structure should be provided with a solid deck to carry a ballasted track. As the roadway of Mosholu Parkway is carried on a bridge across Webster Ave., and as the elevated railroad structure is built above the bridge, the structure is considerably above the level of Webster Ave. line at this point, the maximum distance from the street level to base of rail being 43.4 ft. (Fig. 2).

FIG. 2. WEBSTER AVENUE ELEVATED RAILWAY NEAR MOSHOLU PARKWAY CROSSING, WHERE PRECAST FORM SLAB CONSTRUCTION IS BEING APPLIED

The solid deck was designed as a concrete slab of minimum thickness 6½ in., laid on the top of the longitudinal track stringers and trusses. In estimating the cost of placing the concrete slab it soon became apparent that the cost of formwork would become an unreasonable proportion of the total cost of the slab, in fact would amount to more than 50 per cent of the total cost.

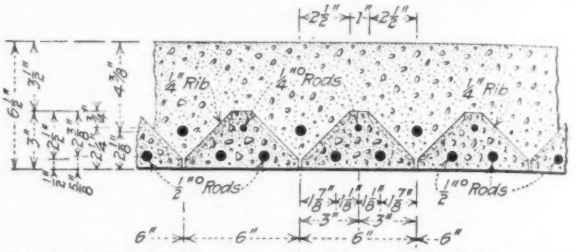


FIG. 1. CONCRETE SLAB RAILWAY FLOOR CONSTRUCTION WITH PRECAST FORM SLABS

This is partly due to the structure not being uniform, so that the forms would have to be reconstructed each time they are used, partly to the difficulty of removing the forms, and partly to the high cost of lumber. It was therefore attempted to find some material which could be left in place, whereby the cost of removing the form would be saved.

The material that suggested itself as most suitable for this work was concrete cast in advance and placed on the top of the structure. It was further conceived that by making this precast form of a general triangular shape and of a maximum width no larger than the spacing distance of the reinforcing rods a precast concrete form might be made deep enough to be sufficiently strong to carry the construction load without losing any appreciable construction height, because the reinforcing rods could be placed near the bottom of the triangular space between two adjacent form slabs. Upon investigating the stresses it was found that the horizontal shear along the plane betwen the form slabs and the deck concrete would be so small that there was no reason to believe that when in place the form slabs would not act as a part of the complete slab, at least if the contact surface were properly corrugated.

For the purpose of proving the truth of this, a number of sample form slabs were made for test. They are shown in Fig. 3. They were made 7 ft. long, 6 in. wide and 3 in. deep, reinforced with two ½-in. square bars at the bottom and one ¼-in. round bar at the top. This last bar was put in only for the purpose of securing the slabs against breaking while being handled. Some of the slabs were provided with a crosswise corrugation on the upper faces, 1½ in. wide and ¼ in. deep. Other test slabs were provided with recesses 6 in. from the end, 6 in. long and ¼ in. deep. The purpose of these corrugations and recesses was to provide mechanical bond. Some weeks after

these form slabs were made testpieces, as also shown in Fig. 3, were cast. The composite testpiece is 7 ft. long, 14 in. wide and 6½ in. deep, the bottom part consisting of two of the sample form slabs set side by side. This was to represent the conditions of the complete floor, and was, therefore, reinforced with additional rods as shown on the drawing. The center rod is a ½-in. square bar and the two side rods are ½-in. square bars because they provide reinforcement for only about one-half the width of that in the center. The integral testpiece shown is such as the floor would be if constructed without the precast slabs. The reinforcement of this testpiece was made the same as that in the composite testpiece. The distance from the top of the slab to the center line of the reinforcing rods is 5⅞ in., the same as the distance from the top to the neutral axis of the steel reinforcement in the composite testpiece.

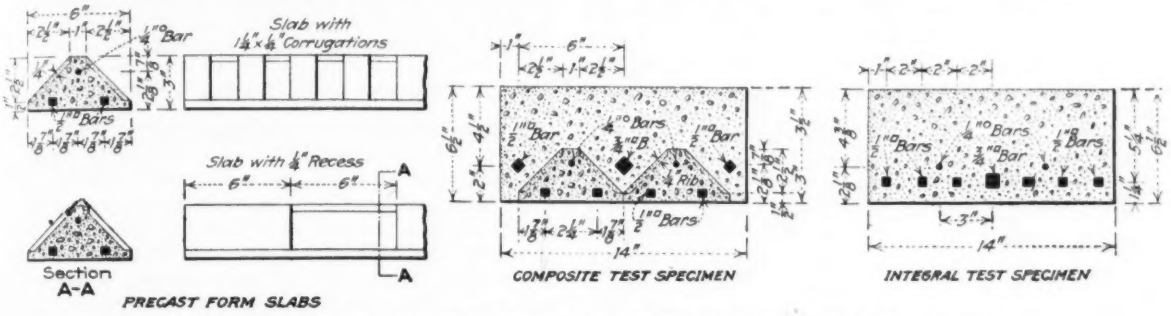


FIG. 3. FORM SLABS, AND COMPOSITE AND INTEGRALLY CAST TEST SPECIMENS

The testpieces were tested to destruction from 19 to 34 days after being made. At the same time one of the triangular precast slabs was tested which was 51 days old. The test was carried out by supporting the ends of the slabs so that there was a clear span of 6 ft. and the load was applied gradually at the center until failure. Three slabs of each type were tested. The accompanying table of results shows that the slabs in which the precast pieces were incorporated broke at a higher load than the monolithic slabs. The explanation of this is probably that while the distance from the top of the slab to the neutral axis of the reinforcement bars was the same as the distance from the top of the slab to the center of the reinforcement bars in the monolithic slab, some of the steel was at a greater distance from the top and that, therefore, the effective depth of this slab was greater.

Owing to the satisfactory results obtained by the tests, it was decided to use this method of construction of the concrete deck, and the precast concrete pieces are now being made.

The question may suggest itself, why were not the precast slabs made of such a depth that no additional concrete would be required. That this was not done is due to the following reasons. The anchorage of such a bridge deck would be uncertain and expensive; the slabs would have to be cast in a number of different sizes to fit the structure; the thickness of the slabs would have to vary in order to conform to the slopes required for drainage; and a top coating of mortar would probably have to be applied in order to make a smooth surface for the waterproofing.

On the concrete floor built as described will be placed felt-and-asphalt waterproofing, on this a 2-in. protective layer of cinder concrete, and on this the ballast, 6 in. deep under the tie. At the ends of the solid-floor section of track, ballast curbs of steel are provided.

George H. Pegram is chief engineer of the Interborough Rapid Transit Co. Design and construction of the work described are in direct charge of F. W. Gardiner, principal assistant engineer.

Test No.	Spec. Fig.	Mix	Steel, per Cent	Age at Test, Days	Age of Precast Slab When Placed in Test Slab, Days	Span, Ft.	Breaking Load Lbs.	Type of Load	Remarks
1	1	1:2½:5	6.6	51	..	6	1,062	Concentrated at center	
2	2	1:2½:4	2.8	28	19	6	20,380	Concentrated at center	Precast slab with corrugations.
3	3	1:2½:4	2.8	28	..	6	16,350	Concentrated at center	
4	3	1:2½:4	2.8	34	..	6	17,430	Concentrated at center	
5	2	1:2½:4	2.8	34	11	6	19,868	Concentrated at center	Precast slab with corrugations
6	3	1:2½:4	2.8	19		6	16,960	Concentrated at center	
7	2	1:2½:4	2.8	19	10	6	20,660	Concentrated at center	Precast slab with recess at ends.

Southwark Bridge Being Reconstructed

Good progress is reported in the reconstruction of the Southwark Bridge over the Thames River in London. The old structure, built more than 100 years ago, consisted of three cast-iron arch spans, the central one of 240 ft. and the others of 210 ft. each. Each arch consisted of eight cast-iron ribs, connected by cross-frames and lateral bracing. The structure is being replaced by one of five steel spans ranging from 123 to 140½ ft. The width of the deck is also being increased from 42½ ft. to 55 ft. (35-ft. roadway, two 10-ft. sidewalks). The new piers were constructed on pneumatic caissons, the largest being 30 x 102 ft.; an air pressure of 22 lb. was required in sinking them. A total weight of steel of 2,000 tons is represented in the new bridge, while the old structure is said to have contained about 5,000 tons of cast iron and to have cost £800,000. For the reconstruction, the old bridge was closed to traffic; vehicle traffic was cut off entirely, but a by-pass trestle was provided for foot passengers.

Proposal Advertisements Should Attract Bidders

Under Present Conditions Contract Terms Must Be Explicitly Stated or Else Contractors Will Not Reply

By E. W. Bush

Engineer, Aetna Casualty and Surety Co., Hartford, Conn.

At THE present time an unusual condition exists in regard to the letting of contract work. A large majority of the contractors doing certain lines of work have already obtained nearly all the work they desire, and are now only considering new work that looks especially attractive to them; there are other contractors who, because of the unsettled conditions as to labor and material costs, will only bid on contracts in which they are protected against increased costs. Frequently only one or two bids or possibly none have been offered on work that a few years ago would have attracted at least six to ten bids. Contractors must protect themselves by bidding extravagantly high prices on many contracts that make them carry all of the risk. They cannot do otherwise, and if engineers and owners desire to attract bidders and to let their work at reasonable prices they can best do this by modifying certain of the contract terms that have been generally used in the past so that the contractor is relieved of many of the risks that are so prominently before us at this time. Now is a good time to clean house in this respect, and readjust the contractual relations between owner and contractor on a more equitable basis.

Why not make the advertisements attract bidders to the job? Space which costs from ten to fifty dollars per issue is in many instances practically wasted as far as conveying to the prospective bidder any adequate idea of the proposed work. Frequently the "ad" merely tells him that bids will be received on a certain kind of work but nothing indicates whether the job will amount to $10,000 or $100,000, and he does not know whether his plant and organization will fit the work or not. He can find out, however, by spending the time and money necessary to go to the job, but it would be more satisfactory all around if this information was conveyed to him directly by the advertisement.

Glance at the proposal advertisements in this issue of *Engineering News-Record* and you will note that most of the matter reads as if it was prepared by a lawyer intent on setting forth in precise detail all the safeguards with which the owner surrounds the letting in order to protect his interests, and but little, if any, space advertises anything that is favorable to the contractor. Is it not better to put about all of these safeguards into the "Instructions to Bidders" which the contractor receives with, or is included as a part of, the "Proposal" form and to use the advertising space to convey to the contractor the kind of information that will tell him whether or not he wants to bid on the job?

A recent issue of *Engineering News-Record* carried fifty-six proposal advertisements, and of these only one gave the approximate cost of the work, although this information could in most cases be given without prejudice to the owner. One other proposal conveyed an idea of the working conditions at the site of the proposed work, the price at which labor could be had, the length of haul, etc., for the benefit of the contractor. Seventeen of the fifty-six included the approximate quantities of the main items of the work so the contractor could form a rough idea of the contract, but there were twenty-five others that gave only a very poor idea of the work, and fourteen that conveyed to the contractor no idea whatsoever other than the work was say a sewer rather than a road job. It may be of interest to record in passing that twenty-nine of the fifty-six made no charge, or at least advertised no charge, for the plans and contract, but that nine of them charged $5 or under, and eighteen of them charged from $10 to $50 for supplying the prospective bidder with the plans and contract forms.

It is believed that fair prices and competitive bids can be obtained in every case where the owner and his engineer will draw up an equitable contract, one that lets the owner carry a reasonable share of the unknown factors of cost, and then advertises all of the favorable facts as well as full information in regard to the work.

What the Ad Should Contain

Such an advertisement would look attractive to a contractor if it told him that bids were to be based on present prices of labor, materials and freight, and if there were increases in these, that the contractor would be allowed the increase, also that he *would* be allowed (not *might* be allowed) an extension of time for causes beyond his control. He will be interested to know that monthly payments will be made on materials delivered to the site as well as covering the work performed. If it is a road contract, he will be pleased to learn that there is no five-year maintenance clause in the contract, also that the owners will accept and take over any portions of the road that are completed and opened to traffic. If the engineer has investigated and states in the advertisement that there is a local supply of gravel and sand which will be acceptable in the work, the contractor knows that the job is not likely to be tied up by the failure to keep materials coming. Other pertinent questions are: Is water available at the site; can help be obtained locally or housed locally if brought in from outside, whether there is a trolley to carry men and materials to and from the work, where railroad switches are located, and the length of haul, the character of the roads and country hauled over, the character of the excavation and whether it can be done by steam shovel, grading machinery, etc.

Frequently, public work is advertised and bids are received in order that the amount of the necessary appropriation or bond issue may be fixed, and the work may not be awarded or the contract signed until weeks or months after the bids are received. This ties up the contractor's check and works a hardship on him if the market is rising on labor and materials, as well as leaves him in doubt as to what other work to bid on in the interval. In many parts of the United States public works, like sewers and pavements, are not paid for by cash but by warrants drawn as assessments against abutting property owners, and the contractor must arrange to get these discounted, often at a considerable percentage under their face value, in order to finance his work. Sometimes these warrants are not issued to the contractor until say thirty days after the completion and final acceptance of the work. After a contractor has journeyed a considerable distance once or twice to bid on work let under these peculiar conditions, he becomes quite wary in following up advertise-

ments on work concerning which he knows but little, and in any event he will be much more favorably disposed if he reads in the advertisement that cash payments will be made, and a decision as to the award will be made inside of two weeks after the bids are received.

If a real estate agent has a suburban home to sell he advertises the beauty of its surroundings, its well-built construction, the admirable planting and arrangement of the grounds, etc., in order to attract the prospective buyer. He tries to awaken a desire in the reader of the "ad" to possess this home, or at least go to the site and investigate. Why not break away from the usual form of advertisement and go after bidders for contract work in the same manner; change the contract so the owner assumes a fair share of the risk and then tell the bidder what you have done as well as all the other pertinent facts about the work that will inform him whether or not his organization, plant and financial strength are fitted to the work, and you will without doubt receive fair bids on the work advertised, and enough of them to let the work on a competitive basis.

Water-Works Laboratories in Michigan Are "Manned" by Women

SEVERAL smaller municipalities in Michigan have water analysis laboratories managed by young women. Men are not attracted to the places because of the limited funds available and the "blind alley" status of the positions. The salary question is especially difficult of solution in connection with disinfection plants. Here the work consists largely of chemical and bacteriological analyses, the technique of which can usually be grasped by a woman more quickly than by a man of equal mental training.

When a water supply needs purification either by filtration or disinfection the Board of Health requires laboratory control and the submission of a monthly report of results of analyses. It is desirable that the person selected for this work have some training in bacteriology and chemistry although experience is not absolutely essential. It is necessary that the operators at the pumping station attend carefully to the mechanical details of control in accordance with the findings of the analyses. A man capable of caring for pumping machinery can easily care for the mechanical operation of a disinfection plant.

When a laboratory is to be established a list of equipment is furnished by the State Department of Health and a suitable room selected, sometimes in a school building. A representative of the Department spends two or three days with the analyst giving initial instructions, after which a visit is made once a month for two or three months to correct errors and give further instuction.

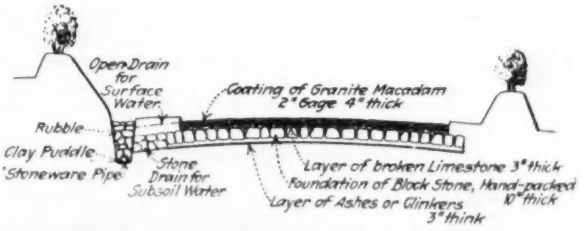
By using the dehydrated, prepared media made by the Digestive Ferments Co., Detroit, bacteriological work is simplified. One who would not be able to prepart media as it is made in large laboratories can easily prepare these media and observe and report the results of incubation with instructions to the operators handling the disinfection apparatus.

According to Edward D. Rich, state sanitary engineer, from whom these notes were obtained, ararngements with teachers in high schools, who do the work in one of the school laboratories, have been made at Hillsdale, Marine City, Sault Ste. Marie, Stambough and Travers City. At Highland Park, Iron Mountain, South Haven and St. Joseph the work is being done by young women in laboratories of the city board of health or in those fitted up by the water departments. Salaries paid range from $30 to $60 monthly for these part time employees. If prepared media are used only one or two hours' time daily is required.

Drainage System for Road With Wet Clay Sub-Base

A SUCCESSFUL method of draining a water-logged clay sub-base was developed in reconstructing 9 mi. of telford-macadam highway from Exeter to Okehampton in England. Along this road the ground is higher on both sides, and surface and subsoil water penetrated under the roadway and softened the clay to the consistency of cream. To remedy this faulty drainage the highway was reconstructed as indicated by the accompanying cross-section redrawn from an article in *The Surveyor* of Jan. 23, 1920. As described by W. P. Robinson, County Surveyor, No. 2 Division of Devon, the construction was as follows:

An intercepting drain of open jointed, socketed stone-ware pipes is constructed along the high side of the road. The trench is filled in with clay puddle up to the level of the center line of the pipes to prevent water from finding its way to the excavated bottom of the trench, and either remaining there stagnant or flowing along the trench under the pipes. The remainder of the trench is filled with hard rubble free from small stones and dirt. Catchpits are constructed at frequent intervals, some in 9-in. brickwork and some in concrete, covered in with reinforced concrete slabs 2½ in. thick, an opening being formed in the side wall of the pits for the entrance of surface water from the carriageway.


Open Drain for Surface Water
Coating of Granite Macadam 2" Gage 4" thick
Rubble
Clay Puddle
Stoneware Pipe
Stone Drain for Subsoil Water
Layer of broken Limestone 3" thick
Foundation of Block Stone, Hand-packed 10" thick
Layer of Ashes or Clinkers 3" think

DRAINS PREVENT WATER FROM PENETRATING SOFT CLAY SUBSOIL

Having in view the importance of not only intercepting water from the higher ground but of draining the road-bed, the old road crust was removed to allow of the new road-bed being formed to a camber of not less than ½ in. to a foot, and this camber was extended outside the width of the new carriageway to meet the intercepting drain-trench on the higher side of the road, and on the lower side frequent trenches were cut and filled with rubble below the level of the new road-bed and leading therefrom through the fence to suitable outlets.

In some places it was deemed advisable to construct, in addition, subsoil drains in the new road-bed, these being laid herringbone fashion leading to the main intercepting drain and consisting of trenches filled with rubble or fascines. With the object of preventing the crossfall of the new road-bed being pressed by subsequent rolling out of its proper shape and the consequent interference with the efficient drainage of the road-bed, fascines and loppings of fir trees were laid in the clinker and the clay subsoil removed to a greater depth adjoining the drain trench.

State University of Iowa's New Hydraulic Laboratory

Description of the New Hydraulic Testing Plant Built by Students of the College of Applied Science

By Stuart Sims

Formerly Associate Professor of Mechanics and Hydraulics, State University of Iowa; Now Professor of Civil Engineering, Oregon Agricultural College, Corvallis, Ore.

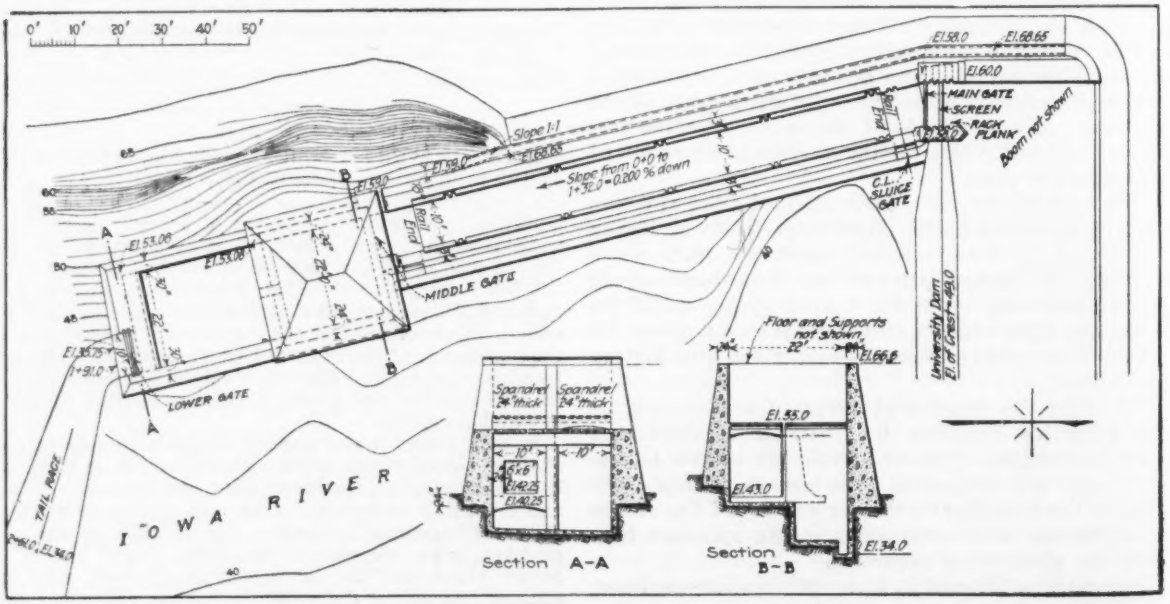
THE State University of Iowa has completed a hydraulic laboratory in connection with a water-power site near the campus. As the laboratory will offer facilities for doing much important experimentation and research work a brief description of the structure should be of interest to those engaged in engineering education and to hydraulic engineers.

Sometime previous to 1905 the College of Applied Science was given a deed to a water-power site in Iowa City upon the Iowa River, upon which was constructed a concrete dam, and power house located upon the east bank. At the western end of this University dam provision was made for a future connection to the proposed hydraulic testing laboratory, which, as then planned, was to consist of a concrete tank 100 ft. long by 10 ft. in width and depth. In the spring of 1915 revised preliminary plans, and estimates of cost were made. In 1917 a legislature appropriation of $15,000 was obtained, which sum has been further increased by an additional grant of $7,000 made during the legislative assembly of last winter. Early in 1918 trips of inspection to the hydraulic laboratories of the Universities of Wisconsin and Illinois were taken, many valuable suggestions and ideas being received. Careful studies of all available matter descriptive of other laboratories were made also, and final plans for the Iowa Laboratory were completed in readiness for construction in June, 1918.

The laboratory is located on the west bank of the river south of the University dam. It consists of three main parts; the testing canal, the basin, and the tail race, this last being merely a canal, cut into the rock, which connects the south end of the basin with the river. The entire structure rests upon a hard blue limestone foundation.

The testing canal, made of concrete, is 130 ft. long, 10 ft. wide and deep; the top of the walls being 4 ft. higher than the crest of the dam. At the northern end where it connects with the dam are located in the order named, a boom, a trash rack, wooden regulating gate 10 ft. wide by 12 ft. deep, with hand operated hoist, and screen slots. Just below these in the east wall nearest the stream, is provided a wooden sluice gate, 5 ft. wide by 4 ft. high, for flushing out the silt which collects above the dam near the mouth of the intake. At intervals of 25 ft. down the canal recesses are placed in the walls to receive stop planks; and on 10 ft. centers, 1 ft. above the bottom of the canal, are 2-in. pipes running transversely through the east wall for the insertion-during tests of piezometer tubes. These pipes, when not in use, are closed by plugs set flush with the wall face. A track of 20 lb. rails, set on the tops of the two canal walls will, with a car, provide facilities for current meter rating. Another 5 by 4 ft. wooden sluice gate is set in the east wall at the lower or southern end of the canal, at which end there is another large gate to close the entrance to the basin. The floor has a grade of 0.2 per cent sloping down to the south. Ladders are located in convenient places for getting about in both the canal and basin.

The basin, formed by concrete walls, is rectangular in plan, 22 ft. wide by 54 ft. long. Twenty four feet at the northern end is covered by a building, the remaining portion being left open. That under the building is arranged so that it can be divided into four parts and so that water entering from the canal can be diverted in any desired direction. In one of these parts is located a wheel setting for the testing of turbines, facilities have also been provided for the installation of weirs, of a Herschel Fall Increaser, and of a 51-in. McCormick turbine. Openings have been



DETAILS OF THE NEW HYDRAULIC LABORATORY OF THE COLLEGE OF APPLIED SCIENCE OF THE STATE UNIVERSITY OF IOWA

left in the concrete cross and end walls so that lines of pipe may be carried from the intake, down the canal, through the basin and out upon the river beach to the south. In the south end wall, at the south corner of the basin, is an opening to the tail race which can be closed by a third large wooden gate.

The floor of the basin, which is pitched to drain to a sump in the northeast corner, lies in general about 8 ft. below that in the canal, and about 6 ft. below the low-water stage of the river, on the downstream side of the dam. However, the slab forming the wheel support and the part connecting it to the canal are placed at an elevation 12 in. below the floor in the end of the canal and, therefore, approximately 7 ft. above the general floor level.

The building, over the upper part of the basin, is 26 ft. square, of brick with a tile roof. It is so planned that it can be extended to the south over the entire basin, when additional floor space is required; and when this is done the resulting structure will be 26 x 58 ft. over all.

Aside from the equipment already mentioned nothing in this connection has been definitely decided upon as yet. Funds are, however, available for this purpose when wanted.

Construction of the plant was done by force account, the majority of those working being students in the engineering college. All displayed intelligence, loyalty and industry to a very gratifying degree.

The large stones blasted from the excavation were all placed in the concrete walls, approximately one-third the volume of the forms being filled with this material so that the resulting cost per cubic yard of the finished walls was about $4.70 in spite of the very high unit prices of materials used.

As now completed the laboratory will be adapted more to the purpose of research than to that of undergraduate instruction, though it is hoped that the necessary space and equipment for the latter will be provided in the near future.

Two problems that give promise of being worked upon very soon are an investigation of the Herschel Fall Increaser, and a study of the flow of water through drain tiles of various sizes. With plenty of water available it is possible to make tests on full size models of all forms of hydraulic apparatus adapted to low heads, as well as to investigate many other phenomena not clearly understood.

Preliminary plans for the laboratory were made by Professors J. H. Dunlap and R. E. Hutchins of the College of Applied Science. Preparation of final plans and the supervision of construction were by the writer. W. G. Raymond is Dean of the College of Applied Science, S. M. Woodward, Professor of Mechanics and Hydraulics.

Current American Shipbuilding

On June 1, 1920, private American shipyards were building or were under contract to build for private ship owners 345 steel vessels of 1,060,643 gross tons, compared with 348 steel vessels of 1,391,341 gross tons on May 1, 1920. This is the first decline since July, 1919. These figures do not include government ships building or contracted for by the United States Shipping Board out of money voted by Congress.—*Commerce Reports.*

Solution for Highway Curve Problem With P.I. Inaccessible

By C. H. Olmstead
Resident Engineer, Tennessee State Highway Department, Nashville, Tenn.

In computing curves when the *P.I.* is inaccessible, the method here described gives the lowest degree of curve which will meet the requirements of location, and it is also shorter than other methods. In this case the curve is treated as being composed of two curves of the same degree and having the *P.T.* of the first coincident with the *P.C.* of the second. The limiting factor is that the sum of the tangent lengths for the

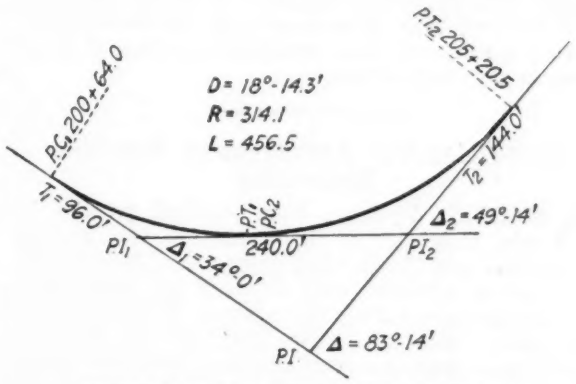


DIAGRAM FOR SOLVING CURVE PROBLEM

two curves must equal the distance between the two *P.I.'s* which are to be used.

For example, take the curve shown in the accompanying figure. The known quantities are:

$\Delta_1 = 34°$; $\Delta_2 = 49°\ 14'$; distance $P.I._1$ to $P.I._2 = 240$ ft.

In any curve tables find the tangent for one degree curve for each Δ. These divided by the degree of curve which is to be found are the tangent lengths whose sum is 240 ft. Thus:

$$\frac{1751.8}{D} + \frac{2625.4}{D} = 240\ ft.$$

$$D = \frac{4377.2}{240} = 18.238\ deg. = 18\ deg.\ 14.3\ min.$$

$$\text{Then } T_1 = \frac{1751.8}{18.238} = 96; \quad T_2 = \frac{2625.4}{18.238} = 144$$

$$Radius = \frac{5730}{18.238} = 314.1\ ft.$$

$$Curve\ Length = 2\pi R \frac{\Delta_1 + \Delta_2}{360} =$$

$$2 \times \frac{22}{7} \times 314.1 \times \frac{34.0 + 49.23}{360} = 456.5\ ft.$$

The value $\frac{22}{7}$ can be used for π in nearly all cases and greatly simplifies computations.

The deflection for 50 ft. of arc is 4 deg. 33.6 min. and the deflection per foot of arc is 5.47 min.

Station of first *P.I.* = 201 + 60

Station of first *P.C.* = 200 + 64

Station of first *P.T.*, 205 + 20.5

In running a curve it is good practice to figure the deflections from the *P.T.*, setting up over the *P.T.* instead of the *P.C.*, which eliminates one set up. Then:

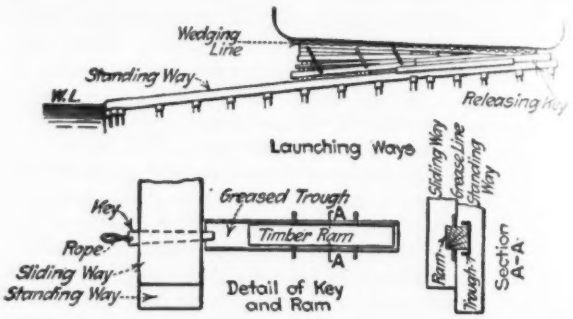
Station	Deflection	Station	Deflection
P.T. 205 + 20.5	0° 00′	202 + 50	24° 40′
205	1° 52′	202	29° 14′
204 + 50	6° 26′	201 + 50	33° 47′
204	10° 59′	201	38° 21′
203 + 50	15° 33′	P.C. 200 + 64	41° 37′ = ½Δ
203	20° 06′		

In cases of the inaccessible *P.I.*, the middle tangent can be made to approximate the center of the present road. With the method described the curve must touch this tangent, thus doing away with the necessity of taking the external into consideration, which must be done in any other method.

Key-Releasing Arrangement for Side Launching

A MARKED departure from standard practice in side launching is in successful use at the Merrill-Stevens Shipbuilding Corporation, Jacksonville, Fla., where 6,000-ton steel steamers are being built for the Emergency Fleet Corporation. A simultaneous key release at all of the launching ways replaces the usual rope release of current practice in the Great Lakes yards (described in *Engineering News-Record*, Jan. 2, 1919, p. 7). The new method, sketched in the drawing herewith, has the purpose of avoiding concentration of the downward pull of the ship at a few anchorages, as occurs with the rope release; it actually eliminates the pull by distributing it to all the ways, where it is neutralized by the lateral thrust of the ship's cradles due to the slope of the ways. In the soft soil in the Merrill-Stevens yard, anchorages would have been very costly, and this fact led to the adoption of the key-release arrangement, devised by Frank H. Owens, Superintendent of Hull Construction at the yard.

In the accompanying drawing are shown the essential features of the arrangement. There are twenty-one ways, spaced 16 ft., and laid on a slope of about 0.118 ($1\frac{3}{32}$ in. per ft. The way timbers are about 70 ft. long. The support of the ship on each way consists of short transverse cradles at the lower side and a longitudinal sliding way in the upper half, the two together supporting the ship by blocking timbers and wedges. Near the upper end of the sliding way, both the sliding and ground ways are notched out on the sliding surface, these notches registering in the starting position, so that a timber key thrust through the hole formed by the notches locks the sliding way in position. Thus, when the ship is wedged up preparatory to launching, it is held by the twenty-one keys. When the ship is to be launched all twenty-one keys are driven out simultaneously. The equipment for this purpose consists of a wooden ram driven against the point of the key by four men; the ram slides in a greased trough and two men can operate it easily, so that with four men at each ram there is little chance of lag at one of the keys from "stage fright" or other cause when the pistol-shot signal for releasing is given. Opposite the large end of the key a fifth man is stationed, handling a rope attached to the key, by which



CRADLE AND RELEASING-KEY ARRANGEMENT AS USED FOR SIDE LAUNCHING AT MERRILL-STEVENS YARD.

he pulls it out of the way if the blow of the ram does not send it clear.

This arrangement has proved successful in launching both steel and wood ships. In the launching of the 6,000-ton steel steamer "Wekika," only one key, No. 12, failed to release, and this one key easily sheared off under the pressure brought to bear on it by the ship. It is claimed that as many as four keys could fail to release and be sheared off without endangering the launching.

Careful measurements made during the launching of the "Wekika" by research engineers of the Emergency Fleet Corporation showed that the initial coefficient of friction was 0.11, and that after about 3½ sec., during which time the ship moved a little less than 3 ft., the coefficient dropped to 0.046 and remained at this value throughout the rest of the ship's travel.

Italy Creates Experimental Road Institute

The Italian Touring Club has recently promoted an experimental institute of roads for the study of materials employed in the construction and maintenance of highways. The objects of the institute will be to carry on laboratory experiments on the physical and mechanical characteristics of road materials; to help the progress of experimental technics relative to highway surfacing by reproducing and studying samples of pavements worn by traffic or deteriorated otherwise; to form a collection of material samples suitable for Italian road construction; to collect all descriptive and statistical matter appertaining to Italian roads; to furnish public bodies with useful advice relating to construction and maintenance of roads, and to forward by every other means the development and betterment of road work in Italy. The institute publishes monthly reports of its proceedings. The institute is financed by annual contributions from the Touring Club of Italy, by an annual subsidy from the Ministry of Public Works and by annuities, gifts and charges made for materials tests. The institute is under the direction of Sig. Italo Vambone, formerly chief engineer of the Province of Milan. More detailed information regarding the formation of this institute is given in a recent bulletin of the Permanent International Association of Road Congresses.

Stone Exportation in 1919

According to a recent bulletin issued by the U. S. Geological Survey, 1919 was the banner year for the exportation of stone from the United States. The value of the stone exported was $2,779,389.

Chlorinated Water Destroys Metals in Intake Works

Vacuum Believed Responsible for Action in Suction Lines at Sacramento, California

By C. G. Gillespie
Resident Engineer, Filtration Division, Sacramento, Cal.

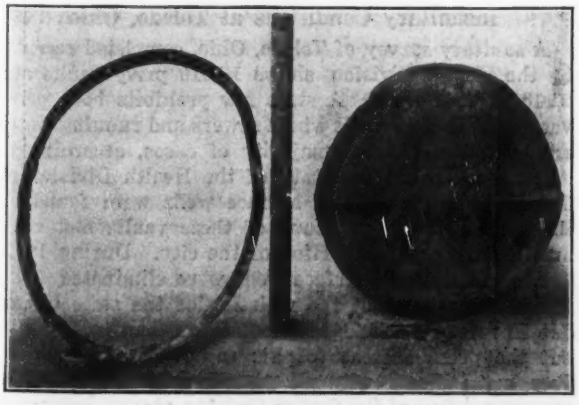
During the fall of 1919 evidence accumulated at the intake system of the city waterworks at Sacramento, Cal., indicating that chlorine gas was exerting a destructive effect on nearly all valves on the pump suction lines to which chlorine was applied for water disinfection. This led to an investigation of conditions in the intake system, resulting in discoveries set forth below.

The water supply at the intake is pumped from the Sacramento River direct into the mains. The only treatment is by liquid chlorine delivered through two solution-type chlorinators into the three suction pipes leading in from the river, the point of application being from 12 to 80 ft. from the three main pumps. All three suction lines are interconnected and are therefore drawn upon continuously unless purposely shut-down. In practice chlorine is applied to but two of them—the two which have suffered by valve corrosion.

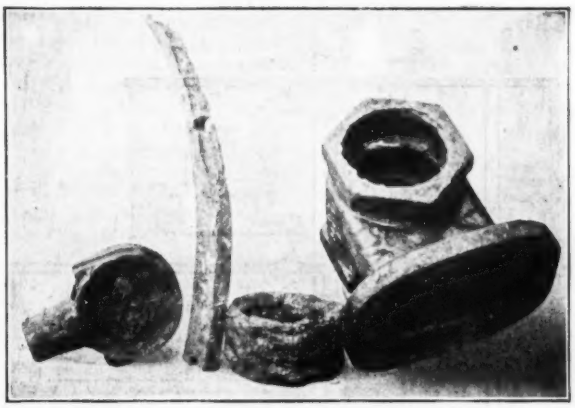
The suction lines are 20, 30 and 40 in. in diameter respectively, and the valves affected include two 3-in. priming valves; one 12-in. valve, installed about 15 years ago; one 24-in. valve, installed about 2 years ago; two 30-in. valves, which have been installed for about 20 years, and also one 42-in. valve installed for about the same period.

The chlorination of water at this intake began in February, 1915, at which time the city used three float-type meter, solution-feed machines located at the suction inlets at the river, about 276 ft. from the pumping station. The calculated time of travel from the point of chlorination to the pumps ranged from 1 to 5 min., averaging three minutes.

In February, 1917, the chlorinators were moved into the station to afford more frequent attention. Since that time all the points of chlorine application have been within the station, and not more than 25 ft. from the valves which have since shown corrosion. All of the valves affected were installed in an upright position on active suction lines and were generally open, with the exception of the priming valves. The 24-in. valve, which was the newest one affected, has not been open more than the others. With the exception of this valve, the open valves are all operated on non-rising stems.



THIRTY-INCH VALVE DISC, STEM AND SEAT RING SHOWING EFFECTS OF ATTACK



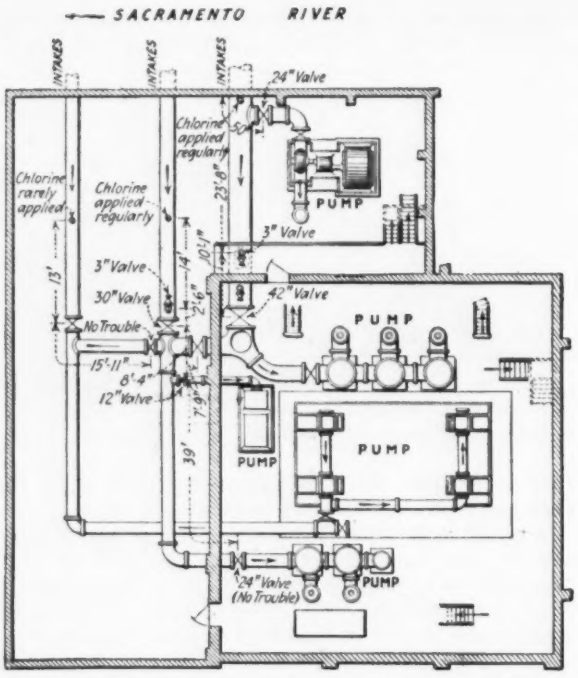
BADLY CORRODED PRIMING VALVE AND OTHER PARTS

Approximately 16,000,000 gal. of water are pumped per day and 1,400 lb. of chlorine are used annually, equivalent to an average dose of 2.4 lb. of liquid chlorine per million gallons of water. The suction lines are under a partial vacuum of 15 ft. for six to seven months of the year; the remainder of the time they may operate under a slight pressure.

One of the common symptoms of destruction which appeared early was a chattering in the valve. When the operators attempted to lower the discs, they would suddenly drop, due to the fact that the threads on the stem, just below the wedge, were completely eaten away. The 24-in. valve, however, was hydraulically operated and therefore used a rising stem. This stem did not exhibit any destruction. In this valve the principal symptom of trouble was the fact that when closed leakage past it occurred.

The trouble incident to the corrosion of the valves having non-rising stems was particularly serious. When a stem severed its connection with the disc, the only way the disc could be raised was by closing down the pumps while new stems were inserted or the bonnet removed. In a direct system, such as this one in which all pumps and suction lines were taxed to the limit, this operation contributed no small hazard in maintaining a water supply.

The general appearance of valve parts which it has been possible to examine are shown in the accompanying illustrations. They show typical conditions. Invariably the portion of the stem within the bonnet, exclusive of that protected by the threads of the wedge and that which extended into the flowing stream, was eaten away and the threads shapeless or gone. This is perhaps the most noticeable and serious aspect of the action because it may suddenly interfere with the use of the suction line at a critical time. The disc rings were usually pitted and thin with a maximum corrosion about one-third of the way back from the crown of the disc. The cast iron discs themselves were as soft as graphite and in fact greatly resembled this metal to a depth of fully ⅜ in. These discs were either pitted and rough, or worn as by the action of a fine sand blast. The effect on the discs was likewise most extensive near the upper periphery. No inspection has been possible of the seat or seat rings, as none of the lines could be thrown out of service for a sufficient interval. Certain 3-in. priming valves on the upper part of the lines, usually closed, were



ARRANGEMENT OF INTAKE SYSTEM AND VALVES WHERE CORROSION OCCURRED

most affected. The wrought iron riser first gave way and frequently the upstream face of the valve itself completely disappeared as by a cancerous action and even the threads on the pipe adjacent were destroyed.

All the metals found in the valves were attacked and, so far as examination disclosed, with equal severity. In some valves the brass stems seemed to have been attacked the more severely while in others the wrought iron gave way first and in still others the cast iron had suffered the greatest deterioration. No make of valves installed near the points where the chlorine was applied was exempt. On the other hand the castiron air chamber just beyond one of the first valves to be attacked has not yet failed, although it is possible that disintegration may be going on. The steel pipes constituting the suction lines were examined by drilling and appear to be unaffected. Valves on the suction lines about 63 ft. from the point of application of the chlorine have shown no signs of being attacked.

All things considered, it seems certain that the destruction of these valves can be charged wholly to the action of chlorine gas which accumulated in the valve bonnets and high places on the suction lines, not having been absorbed by the time it reached the trap so formed. It is probable that the existence of a partial vacuum promoted the liberation of the gas from the stream. Nevertheless, valves more or less remote were apparently not affected and this would indicate gradual absorption of chlorine in spite of vacuum conditions.

Judging by the extent of the action on these several valves, and particularly on the 24-in. valve, which was but two years old, it is at once apparent that here is a phase of chlorination that should receive the most thoughtful attention.

Based on this expensive and hazardous experience it is suggested that chlorine be not applied to suction lines under partial vacuum within 100 ft. of any valve or high pocket. Moreover, it would be well to use all such helpful precautions as ample dilutions, the diffusion of chlorine in the pipe, the installation of valves horizontally rather than upright and, finally, the use of duplicate facilities to permit valves to be repaired.

S. W. Kay is superintendent of the water works and practically all of the history of this experience was obtained from him.

Impact Tests on Road Concrete

INVESTIGATIONS of the wearing quality of road concrete were made by the Highway Department of Pennsylvania recently and reported in a paper by H. S. Mattimore before the American Society for Testing Materials. The paper is entitled "Impact Tests on Concrete to Regulate Coarse and Fine Aggregate Qualities and Mixtures for Highways." The instrument consisted in a cam actuated lever at the end of which were placed vertically eight points with non-slip calks which dropped 4 in. at the rate of 90 r.p.m. on the circular upper surface of a 6-in. cylinder. These cylinders were in general cut from a road in which varying kinds of concrete and finishing methods were used. However, some test specimens of concrete were poured as cylinders particularly for the tests. The amount of loss of the specimen under the continual blows of the points was used to compute a so-called impact coefficient.

The results were not profoundly convincing, though the author has made the following definite conclusions based on a study of the data:

1. The qualities of both coarse and fine aggregate influenced both compression and impact wear tests.
2. The quality of the fine aggregate has a greater effect on the impact wear test than that of the coarse aggregate.
2. A 1:2:3 mix gives more uniform results in impact wear tests in a mix with a larger proportion of coarse aggregate.
4. The 1:2:4 and the 1:1½:3 mixes are affected to a greater extent by the quality of the coarse aggregate than a 1:2:3 mix.
5. Where an excellent quality of fine aggregate is to be used with a medium quality of coarse aggregate a 1:2:3 mix should be used.
6. Where an excellent quality of coarse aggregate is to be used with a medium quality of fine aggregate there is very little difference in impact wear between a 1:2:3 and a 1:2:4 mix, so it may be economical to use the latter.
7. More uniform results were obtained under impact wear tests on specimens from the road, than on the molded specimen.
8. There is no direct relation observed between impact wear tests and compression.
9. Machined finished concrete gives more uniform results in impact wear test than hand finished concrete, although some specimens of the latter give high values.

Insanitary Conditions at Toledo, Ohio

A sanitary survey of Toledo, Ohio, completed recently by the Health Division, shows 16,010 privy vaults and 8,118 surface wells. A state law prohibits both privy vaults and surface wells where sewers and running water are available. In the majority of cases, according to A. A. Greenbaum, secretary of the Health Division of Toledo, privy vaults and surface wells were found on the same properties. Many of these vaults and wells are in the congested portion of the city. During 1919, 915 vaults and 525 surface wells were eliminated. Mr. Greenbaum says that the violation of the state law is due in most cases to ignorance rather than intention—but the press abstract of his report on this subject does not indicate why all persons violating the law are not notified of the fact so that the plea of ignorance will no longer remain.

Decision on Lake Diversion by the Chicago Drainage Canal

District Court Rules Navigation is Paramount and is Impaired by Flow to Drainage Canal—Facts and Opinions in Case

IN RENDERING a decision against the Sanitary District of Chicago in the suit brought by the U. S. War Department to restrict its diversion of water from Lake Michigan, Judge Landis, of the U. S. District Court at Chicago, has held that "navigable rights are paramount." In effect, this decision will grant the War Department the right to an injunction against the diversion of more than the 250,000 cu.ft. per minute originally permitted but now exceeded considerably. It is understood that he has withheld the order for some years past, partly in the hope of an adjustment of differences between the Sanitary District and the War Department.

Thus far, Judge Landis has given only an oral opinion and the formal entry of an order restricting the flow of the drainage canal is suspended to permit of an appeal to the U. S. Supreme Court. Apart from this suit brought by the U. S. Government, the Sanitary District has made application to the Secretary of War and the Chief of Engineers, U. S. Army, for approval of its proposal to compromise the controversy with the U. S. Government. If this should be approved, the present case would cease to exist.

Some particulars of the case, with viewpoints of the officials of the Sanitary District of Chicago, are given further on. The main part of the report of the judge's oral opinion follows:

The charge is that the Sanitary District of Chicago is taking an amount of water (and proposing to take more) which causes the impairment of the navigable capacity of the Great Lakes, excepting Lake Superior, and that such impairment, without the consent of the Federal authorities at Washington, entitles the government to an injunction. The defense of the Sanitary District is that there is no impairment and, primarily, that if there is an impairment it is necessary for the sanitation of this great territory.

Examination of the proofs on the question whether the taking of this water is felt or not, leads me to the conclusion that there is a lowering of the surface of the lake. In making that statement I have in mind the traditional variation of the lake levels, known to all men that know anything about it. The taking of the vast volume continued unceasingly has resulted in the lowering of the level of the lake and in reversing the current of the Chicago River.

The variation is only a matter of inches in Lake Michigan. It is without doubt, in my judgment, on the evidence of the matter, a matter of inches. Even though it be no more than three or four inches, having in mind the state of proof as to the depth of the harbors in the Great Lakes, it is directly an impairment of navigable capacity. The question of fact, whether there is an impairment or obstruction here, is beyond controversy. The fact is clearly established that there is such a change in the lake level, in my judgment, that in low lake level time the level is lower and in high lake level time it is less than it would be but for this diversion. [In answer to a question by the judge it was stated that at present the diversion is approximately 480,000 cu.ft. per minute.]

The finding of the court is, on the evidence in this case, that diversion has resulted in the lowering of the lake level and the reversal of these currents, which latter fact is not controverted. On the evidence that the lowering is an impairment of navigable capacity, even though it amounts to no more than three or four inches, and as to the lowering to that extent there could be no controversy on the record, the court's finding is against the contention of the defendant [the Sanitary District] on the proposition that this is a necessary thing for the salvation of this community. That is, that without this water this community will be at the mercy of disease germs from which it suffered before this diversion began and from which it has by this diversion been practically relieved, as shown by statistics.

The court has complied with this rule of law, that navigable rights are paramount, and even though the Sanitary District is driven to the necessity of making some other provision, granting that the War Department and Congress should refuse to give contention to this question of sanitation [i. e., refuse to permit the desired diversion in the interests of sanitation?], it is entitled to the law, which I must obey, that a navigable right is paramount. In the last analysis, should Congress and the War Department, in consideration of all these matters, decline to permit the necessary diversion, the burden is on the District of providing some other method of relief. In other words, the defense that the diversion is necessary for the purposes of sanitation, as against the rule that a navigable right and navigation right is a paramount right, is immaterial.

The order will not go into effect until 30 days [afterwards changed to 60 days] after the Sanitary District has an opportunity to present to the Supreme Court of the United States an application for supersedeas; that is, 30 [60] days after the date fixed for the meeting of the Supreme Court in October.

From the beginning, prior to the diversion and down to 1907 or 1908, the constant attitude of the Sanitary District was a recognition of the control of the Federal Government over this whole question, everything that was done by the Sanitary District in the way of diversion being in a permit granted by the War Department on application of the Sanitary District to that end. The Sanitary District shall have an opportunity to apply for further relief to the War Department at Washington. Under no circumstances does this order go into effect now. The thing that the court wants, being a citizen of Chicago, the thing I want, is water without microbes.

This decision restricts the diversion of water to 250,000 cu.ft. per minute, the limit set by a permit of the Secretary of War in December, 1901, after protest by the navigation interests against a flow of 300,000 cu.ft. per minute which had been granted conditionally in 1899. This restriction on the flow was based on navigable velocities in the Chicago River. The Sanitary District then commenced to widen and deepen the river, removing fifteen center pier bridges and providing wider channel openings at a cost of $12,000,000, in order to give sufficient cross sectional area for a flow of 600,000 cu.ft. per minute without excessive velocities.

Numerous applications for permission to take a greater quantity of water from the lake have been made by the Sanitary District, but without avail. After an application for an additional draft of 240,000 cu.ft. per minute through the Calumet River and Sag canal had been denied by the War Department in 1907, President Roosevelt suggested that a friendly suit be brought to determine the rights of the Secretary of War. Suit was then commenced in 1908 with reference to the Calumet-Sag diversion. Later the case was enlarged to cover the entire diversion, and an injunction was asked to prevent the original draft of 250,000 cu.ft. per minute being exceeded. It is this case which has now been decided in the U. S. District Court.

It may be noted in passing that the actual diversion has exceeded the prescribed limit, the flow through the Chicago River to the canal, according to the Sanitary District official, having been from 420,000 to 540,000 cu.ft. per minute.

Navigation interests have not been alone in their fight against increased diversion of water for the drainage canal. Cities located along the lakes have opposed such diversion on the ground of its alleged effect in lowering the lake levels and thereby reducing the depth of water in the harbors. Private power interests have joined in the opposition, since they object to the public authorities developing water power at the lower end of the canal, and possibly in future along the Illinois River if the Illinois waterway project should be carried out. It has been stated by the Sanitary District, however, that no additional draft or diversion has been made for power purposes, the power plant at Lockport simply utilizing the flow normal to the operation of the drainage canal.

Even should the present decision be reversed by the Supreme Court, Chicago will still be faced with a sewage disposal problem. At a meeting of the Illinois Society of Engineers in 1919, it was stated by C. D. Hill, chief engineer of the Chicago Board of Local Improvements, that should the government give permission to operate the drainage canal at its full capacity, it would still be necessary to install auxiliary purification works, for "the time is approaching when some method of supplementing dilution must be adopted."

Recognition of this necessity by the Sanitary District is the reason for its activities in pushing the treatment of sewage from the packing house district and studying preliminary treatment of the sewage in excess of the amount that could be diluted properly by the maximum flow in the canal. The effluent from the sewage-works, it is held, would require relatively slight dilution to render it innocuous. For the same reason the Sanitary District is studying the treatment of industrial wastes and is providing for the treatment of sewage in localities where it is impracticable to obtain the amount of water necessary for dilution, as along the Desplaines River. But if the flow should be restricted to the amount stated under the recent decision, the officials of the Sanitary District say, a much more extensive and costly program of sewage treatment would be required.

The Sanitary District has proposed to pay for the construction of controlling works at the head of the St. Lawrence River and at the outlet of Lake Erie, in order to regulate the flow from the Great Lakes and thus, the district maintains, more than compensate for any possible lowering of the levels of the lakes due to a total diversion of 720,000 cu.ft. per minute from the lower end of Lake Michigan. (See *Engineering News-Record* of July 31, 1919, p. 231). The District holds that this would provide more uniform flow for power at Niagara and along the St. Lawrence. A report on Niagara River regulation, made to the Sanitary District of Chicago by F. C. Shenehon, was summarized at length by Mr. Shenehon in *Engineering News-Record* of Feb. 12, 1920, p. 308. The cost of those controlling works, it is said, would be very much less than that for the enoromus sewage-works which would be necessary under conditions of restricted flow in the drainage canal, and the former would involve relatively little expense for operation.

The officials of the Sanitary District feel that although the most obvious function of the drainage canal is the disposal of the sewage of Chicago by dilution, yet its main function, from a health protective viewpoint, is the almost complete diversion of all sewage from the drinking water of the cities along the lake, including Chicago, Evanston, Glencoe, Winnetka, Kenilworth and Wilmette and adjacent Indiana towns.

This diversion of the sewage, together with intelligent chlorination of the water, Chicago interests hold, has been responsible in a large part for the remarkable lowering of the typhoid fever death rate of Chicago to the record figure in 1919 of 1.19 per 100,000. The success of the diversion, the Sanitary District holds, depends on a flow of 600,000 cu.ft. per minute, which is the estimated flood flow of the Chicago River. With the proposed restricted diversion of 250,000 cu.ft. per minute it is held to be impossible to keep the river from discharging into the lake at frequent intervals, thereby endangering the water supply. Extended field tests, it is said, have shown that about 24 hours are required before an increase of flow at the outlet of the drainage canal at Lockport affects the flow at the entrance of the Chicago River.

During the past year the Sanitary District has been endeavoring to arrive at a solution of the entire problem which would satisfy all parties, including navigation and power interests, in both the United States and Canada, and also the people along the Illinois River. The program suggested has included not only the control of the Great Lakes, but also a progressive installation of sewage-works, so as to reduce in twenty years the organic load of the canal, both industrial and domestic, to one-half the present domestic load alone. As the population of Chicago increases at a rate of about 500,000 every ten years, this is equivalent to constructing sewage-works for a city of that size every decade merely to keep up with the growth. The Sanitary District holds that the control of the eastward flow at the lakes will not only enable the flow of the St. Lawrence to be maintained in the early fall, so as to benefit harbor conditions in Montreal, but will tend also to make the flow more uniform at Niagara and along the St. Lawrence. In return the Sanitary District requests an assured diversion of 600,000 cu.ft. per minute. This is now under consideration by the War Department.

It is of particular interest to note that at present there appears to be greater harmony between the War Department, shipping interests, the Canadians and the Sanitary District than at any previous time. In a recent public hearing on the report of the Board of Engineers on Rivers and Harbors, at Washington, a plan was presented which appeared to appeal to all as a practical solution. This report recommends:

(1) The Sanitary District should be allowed the use of water necessary for the dilution of sewage now entering the Chicago River and to prevent the river from flowing into the lake. This flow is taken at 600,000 cu. ft. per minute. (2) Works to compensate for lowering the levels of the lakes by this diversion to be built at the expense of the Sanitary District. (3) Diversion from the lake not to exceed the amount mentioned above, but the Sanitary District must be obligated to proceed with a comprehensive plan for treating the sewage of the population beyond the limits of dilution by the maximum prescribed flow. (4) Diversion of water from the lake must be so effected as not to injure navigation in the Chicago River. (5) The Calumet-Sag channel project and diversion is to have special consideration, with particular reference to needs of Indiana towns. (6) Pollution of lake waters by ships is to be prevented.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

The Growth of Technical Journals and of Technical Books

Experiences and observations in the fields of technical journalism and the publication of technical books were a feature of a recent address by Edward H. Caldwell, treasurer of the McGraw-Hill Co. and also of the McGraw-Hill Book Co., at a dinner given in honor of his completion of thirty years of service with the companies named and their predecessors. After leaving Cornell in 1888, Mr. Caldwell was first engaged in electric railway work with the old Sprague company. He then joined the staff of *Modern Light and Heat*, published in Boston. In May, 1890, he met Dr. Louis Bell, then editor of the *Electrical World*, who invited him to become his assistant. For a year or so these two were the entire editorial staff of the *Electrical World*. After sketching the growth of various engineering journals Mr. Caldwell said: "It is interesting to note that six of our present group of 10 papers [published by the McGraw-Hill Co. in New York] have been published for more than thirty years, having absorbed at least ten others, while the other four were established as necessary to carry out the ideals of service to be rendered." Mr. Caldwell's remarks in passing from technical journals to technical books and on the latter subject were, in part:

"I might go on indefinitely pointing out the great strides that have been made in the material development of the country since the clear vision of Rothwell, Wellington, Frost, Johnson, Swetland, McGraw and others first saw the need of the periodicals which they founded; and just as clearly saw the great service which these periodicals could render in spreading engineering information, and in giving assistance in the expansion and upbuilding of the material elements of our modern civilzation."

The story of the growth of technical book publishing is just as fascinating and has developed along similar lines and for like reasons. The *Electrical World* in 1890 had published a few books, some of which were technical. In addition to my duties as managing editor, make-up, news editor, purchasing agent for engravings, and as treasurer of the company I was given the job of looking after the manufacture of new books. One of the first that I put through the press was Tesla's "Alternating Currents"—a book still in print. It was at this point that Mr. Weaver joined the staff and took over the book work—especially its editorial supervision—as his first duties. Both the *Engineering and Mining Journal* and *Engineering News* at that time had book departments.

With the expanding industries and the increasing army of graduate engineers the supply of technical information in book form became more important. Editors frequently speak of books as the morgue in which the journalistic product is embalmed. But it is more nearly the truth to say that the book gives a new and greater life to the journals' dying output. The products of the McGraw-Hill Book Co. go far beyond the fields over which the McGraw-Hill papers spread their circulation. I think exact figures would show that the McGraw-Hill Book Co. sells annually about four books for every subscriber on the circulation records of the eleven McGraw-Hill papers.

The growth of the McGraw-Hill Book Co. has been rapid and phenomenal. But there is no mystery about the causes of its growth, for here, as in the publishing company, the governing principle has always been to render the highest *service* to that great army of engineers and students of engineering who not only carry on the world's great undertakings, but who are always in the front ranks doing research and pioneer work for the benefit of society and modern civilization.

I take great pride, with my colleague, Mr. Foss, in the part which the McGraw-Hill Book Co. has had in the widespread circulation of engineering literature of real value. Some idea of the influence of American engineering thought on the far countries of the world may be gained from the fact that we distribute through our London branch not less than 25,000 books a year; that Japan takes nearly or quite 1,000 a month, while China, Australia, South Africa and South America are ordering in constantly increasing numbers.

The growing influence of the engineer in the world's affairs is not an accident. His efforts and his accomplishments would be narrow and almost unknown were it not for the world-wide publicity given by the engineering periodicals and books. Who first spread broadcast the details of the Edison electric light and the Sprague and Thomson-Houston electric railway systems? Probably the *Electrical World* and the *Street Railway Journal*. Who first gave engineers full information about the flotation process? Probably the *Engineering and Mining Journal*. Where do engineers the world over look for the time saving and money saving ideas of their colleagues? You know the answer—to engineering periodicals and books. A good example of this is the Japanese engineer, whether educated at home or abroad, who has read and profited by every line of American and other engineering literature.

Map Reading and Making Simplified

REVIEWED BY H. J. HUGHES

Dean of the Engineering School, Harvard University, Cambridge, Mass.

TOPOGRAPHIC MAPS AND SKETCH MAPPING—By J. K. Finch, C.E., A.M., Associate Professor of Civil Engineering and Resident Director of the Summer School of Surveying, Columbia University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 175; illustrated. $2.50.

During the war it was necessary to teach large numbers of young men, without much mathematical knowledge and unaccustomed to the use of instruments, how to read and use maps and to make topographical and landscape sketches by quick methods for military purposes. And to do this most of those who taught had to change very radically their own method of handling these subjects. Previously, map making had in general been assumed to be engineering work; and engineers for the most part have dealt with maps made by somewhat costly and cumbersome methods, and often with needlessly high precision. It was assumed also by many that the best and perhaps the only good way to learn how to interpret maps was by making them. The experiences of the training camps have not only greatly improved methods of instruction in map reading and making, but also have shown clearly that cheap and quickly made maps may be quite as useful in many kinds of engineering investigations and explorations as more laborious and costly productions. Maps are recognized as essential to the work of geologists, engineers and geographers; but the ability to use maps intelligently and skilfully is also necessary in many other fields. To the trained interpreter a

topographic map is a storehouse of varied information. Maps are a necessity to automobilists and many other travelers, and there is an increasing number of people who find map sketching a pleasant pastime. Many of the schools and colleges have continued the work on map sketching begun during the war for students in the Reserve Officers' Training Corps or in connection with geology or surveying. There is an increasing demand for instruction both in map reading and map making, and this book, which has been written to supply a short treatise on these subjects, is admirably adapted to its purpose.

The text is divided into three parts. The first part takes up methods of indicating on, or getting from, a map the information that it is intended to convey, such as: Location, orientation, scale, relief, drainage, and other features; profiles and sections, slopes or grades of hills, roads and railroads; the determination of visibility and areas, the use of topographic maps in the field for military purposes, and the coördinate and grid systems. A comparison is made of the maps of the United States Geological Survey, the Ordnance Survey of the British Isles, and the Carte de France de l'Etat Major. The second part is devoted to the making of topographic sketches by means of the army sketchboard and the simple equipment which goes with it; free-hand lettering, topograhic drafting, enlargement and reduction, pacing, traversing, position sketching, contouring and the determination of elevations. Part three is devoted to landscape sketching, which is a useful and generally not well understood practice.

The most serious criticsm is that the part on landscape sketching is somewhat brief and could be better illustrated. The reviewer thinks that more should be said about simple solar observations to determine meridian, and that the usefulness of the compass in traversing should be explained and emphasized, and that the use of the "stride" is preferable to the "pace." But these are only minor criticisms of an excellent piece of work.

An appendix of thirty pages contains a descriptive list of the principal topographic maps of the world, which will be of value to anyone whose interest or business requires him to use maps of foreign countries.

The book is a simple, straightforward treatment of the subject of map reading and the making of simple maps, well presented and with commendable brevity. It is a good textbook for schools which give instruction on this subject, and also for anyone who wishes to take it up in a non-technical way.

American Labor: Historically and Today

ORGANIZED LABOR IN AMERICAN HISTORY—By Frank Tracy Carlton, Ph. D., Professor of Economics, De Pauw University. New York and London: D. Appleton and Co. Cloth; 5 x 8 in.; pp. 313. $2.50.

THE NEW INDUSTRIAL UNREST: Reasons and Remedies—By Ray Stannard Baker. Garden City, N. Y.: Doubleday, Page & Co. Cloth; 6 x 9 in.; pp. 231. $2.

Professor Tracy outlines various phases of organized labor in its relation to American history and Mr. Baker deals with the labor unrest of the present day. Each volume is short and readable.

After an introduction and a chapter on "Epochs in the History or Organized Labor," Professor Tracy takes up the American constitution, free schools, land reform and other matters in relation to the wage-earner. There is a chapter on labor parties, Socialism, etc. The last part of the book discusses "The Ideals of the Wage Earner" and pre-war tendencies.

Mr. Baker's book, as its title indicates, is a discussion of the present labor situation, based largely on personal studies during the recent steel strike and other first-hand information. The viewpoints of both employers and employees are presented, those of the latter perhaps in more detail. The last part of the book goes into the shop-council system, co-operation in industry, labor management as a profession and the struggle between autocracy and democracy for industrial control. Some results of co-operative experiments are presented.

Both books are well worth reading and the two may well be read together, taking the historical sketch first.

Centrifugal Pump Impellers

REVIEWED BY ROBERT E. HORTON

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RESEARCHES ON THE THEORY OF THE ACTION OF CENTRIFUGAL PUMP IMPELLERS—By Otogora Miyagi, Kogakuhakushi. Technology Reports of the Tohoku Imperial University, Sendai, Japan. Tokyo: Maruzen Co., Ltd. Paper; 7 x 10 in.; pp. 100; 25 figures in the text.

This is a very complete and clearly written analysis of the theory of centrifugal pump impellers. The analysis is mainly algebraic, and in a form easily followed, although differential equations and integral calculus are used to some extent. It covers the theory of centrifugal pumps in a more extended and complete manner than most standard books in English dealing with this subject.

The general theory is first developed. This is followed by a discussion of natural flow through the impeller when working under no load. The paths of the water particles are then treated for impeller blades developed in different forms of curves. The effect of hydraulic resistances is then considered, and finally, using Weisbach's formula for loss of head due to bends and ordinary coefficients of friction between water and iron surfaces, practical working formulas for impeller design are obtained, including an approximate solution of the problem of determining the efficiency of an impeller having a given design. A single complete example is presented, and solved.

Control and Utilization of the Nile

NILE CONTROL—By Sir Murdoch MacDonald, K.C.M.G., C.B., Adviser, Ministry of Public Works, Egypt. Cairo, Egypt: Government Publications Office. Paper; 8 x 13 in.; pp. 262; illustrated. P.T.20. Vol. I—A Statement of the Necessity for Further Control of the Nile to Complete the Development of Egypt and Develop a Certain Area in the Sudan, with Particulars of the Physical Conditions to be Considered and a Programme of the Engineering Works Involved. Vol. II—Folding Maps.

How to control and utilize the Nile so as literally to make two crops grow where one or none grew before is a problem as old as the Pyramids. A partial control for limited areas was secured centuries ago. In recent years large two-crop areas were established by the Assuan dam and several barrages lower down the river. The present report sums up and carries forward studies made during some years past for the purpose of reclaiming every possible additional acre of Egypt that needs flood protection, or drainage or irrigation. The works recommended to this end are reservoirs on the White, the Blue and the Upper Blue Niles and also at Lake Albert; a barrage at Nag Hammadi "to protect flood cultivation in the part of Upper Egypt as yet unconverted to perrenial irrigation, and to supply it with summer

water when conversion does take place;" and a channel in the Sudd region to assure that the Lake Albert reservoir reaches the Main Nile. It is proposed that these works, including each of the four reservoirs, be carried out in the order given above.

The report deals first with the area, population and water requirements involved in the whole project, then with the several proposals to meet these requirements. Many meteorological and stream-flow data are presented. Among the appendixes is one on the rating and the accuracy of current-meters, one on taking weir discharges through the sluices of the Assuan dam and one discussing briefly the possible value of a second heightening of the Assuan dam.

The Art of Iron Production

NON-TECHNICAL CHATS ON IRON AND STEEL—By LaVerne W. Spring, A. B., Chief Chemist and Metallurgist, Crane Co., Chicago. New York: Frederick A. Stokes Co. Cloth; 5 x 8 in.; pp. 358; illustrated. $3.50.

Mr. Spring makes an unusually successful attempt to explain in language that a school boy can understand the complex and difficult art of iron production. Taking account of the fact that this art has a historical background reaching into the obscurity of earliest ages, and that its present development extends into all the intricacy and refinement of micrometallography, the task grows formidable, and its successful performance is the more to be appreciated. A soundly logical plan of development has been followed in the arrangement of the text; the discussion proceeds from history to raw materials, and then through the successive processes of the iron industry from furnace stock pile to rolling mill. There is even something on the various features associated with the critical points of the cooling curves of iron. While not all of the many photographic illustrations are as clear as desirable, taken as a whole the pictures and the various drawings and diagrams illustrate the work sufficiently for all requirements of the reader. It should be an instructive diversion rather than a piece of hard work to read the book.

PUBLICATIONS RECEIVED

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS: Proceedings of the 1919 Convention—Valparaiso, Ind.: Charles Carroll Brown, Secy. Cloth; 6 x 9 in.; pp. 725; illustrated.

BACK TO THE REPUBLIC: The Golden Mean; The Standard Form of Government—By Harry F. Atwood. Chicago, Ill.: Laird & Lee, Inc. Cloth; 5 x 8 in.; pp. 157. $1.

Enthusiastic propaganda for a return to the most elemental form of representative government contemplated by the American constitution and its application here and everywhere to not only federal but also to state, county and city government and to a single world republic. Against all boards, commissions, and popular or direct legislation. Overlooks possible evolution in government since 1788 or need for variations in government to suit national or more local differences. Short and readable but could be condensed and made more readable by cutting out tiresome repetitions.

A HISTORICAL AND CRITICAL REVIEW OF MATHEMATICAL SCIENCE: Bulletin of the American Mathematical Society. Vol. XXVI, No. 9, June, 1920—New York: The Society. Paper; 6 x 9 in.; pp. 47.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING: Annual Report of the President and of the Treasurer, 1919—New York: The Foundation. Paper; 7 x 10 in.; pp. 148. Free upon request.

EMPLOYMENT MANAGEMENT AND INDUSTRIAL TRAINING: Employment Management Series No. 4—Washington, D. C.: Federal Board for Vocational Education. Paper; 6 x 9 in.; pp 107; illustrated.

ENERGY NECESSARY TO SHEAR STEEL AT HIGH TEMPERATURES—By Guy D. Newton, Associate Professor of Engineering Drawing and Machine Design. Columbia, Mo.: Engineering Experiment Station of the University of Missouri Bulletin. Paper: 6 x 9 in.: pp. 16: illustrated.

HOGG'S WAGE TABLES FOR BUILDING CONTRACTORS—Compiled by Jas. Oliver Hogg, Jr., Assoc. M. Am. Soc. C. E. Kansas City, Mo.: Jas. O. Hogg, Jr., & Co. Leather; 5 x 7 in.; pp. 62. $5.

A set of 59 rate tables worked out for every quarter hour, from 1 to 60¾ hours at varying rates per hour from $0.30 to $1.50

HYDRAULIC TURBINES: With a Chapter on Centrifugal Pumps—By R. L. Daugherty, A.B., M.E., Professor of Mechanical and Hydraulic Engineering, California Institute of Technology; Formerly Professor Hydraulic Engineering, Rensselaer Polytechnic Institute. Third Edition. Revised, Enlarged and Reset. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 281; illustrated. $3.

A third edition of a valuable short treatise. Chapters have been added on governors and design.

HYDRO-ELECTRIC POWER COMMISSION OF THE PROVINCE OF ONTARIO: Report, 1919—Toronto, Can.: The Commission. Paper; 7 x 10 in.; pp. 287; illustrated.

HYGIENE AND PUBLIC HEALTH—By George M. Price, M.D., Author of "A Handbook on Sanitation," "Tenement-House Inspection," etc. Second Edition, Thoroughly Revised. New York: Lea & Febiger. Cloth: 5 x 7 in.; pp. 280. $1.75.

In this edition some revisions have been made and there has been added the report of a committee of the American Public Health Association giving Standard Regulations for the Control of Communicable Diseases. Although containing much information in small compass, the book is marred by misleading statements on engineering subjects and encumbered by mere definitions and categorical statements of little possible value to anyone. The volume appears to be designed for students and amateur health officers.

JAMAICA BAY-PECONIC BAY CANAL BOARD: Supplemental Report Relating to the Construction of the Proposed Canal and the Effect Upon the Present Source of the Water Furnished to Residents of the Town of Hempstead and the Borough of Queens. Albany, N. Y.: The Board. Paper; 6 x 9 in.; pp. 15; illustrated.

THE PORT OF NEW YORK—By Thomas E. Rush, Surveyor of the Port. New York: Doubleday, Page & Co. Cloth; 6 x 9 in.; pp. 361; illustrated. $3.50.

Devoted mostly to the non-engineering features of the country's premier port: history, commerce, smuggling, "port salesmanship," etc. Some concluding chapters on the details of port operation may serve to enlighten the laymen on what the engineer contributes to the port, as distinct from the harbor.

PROPOSED IMPROVEMENT OF THE HARLEM RIVER: Report of the Board of Conference. Albany, N. Y.: The Board. Cloth; 6 x 9 in.; pp. 195; folding maps.

PROPOSED WATERWAY BETWEEN GRAVESEND AND JAMAICA BAYS: Report of the Board of Conference. Albany, N. Y.: The Board. Paper; 6 x 9 in.; pp. 58; folding maps.

THE RELATION OF THE CHEMICAL INDUSTRY OF NIAGARA FALLS TO THE WATER WORKS—By John A. Kienle. Reprinted from Journal of the American Water Works Association, Sept., 1919. New York: Electro Bleaching Gas Co. Paper; 6 x 9 in.; pp. 20; illustrated.

SERVICE AT COST PLANS: An Identical Analysis of Statutes, Ordinances, Agreements and Commission Orders in Effect, or Proposed, Together with a Discussion of the Essentials of Local Transportation Franchises—By Harlow C. Clark, Editor of *Aera*. New York: American Electric Railway Association. Cloth; 6 x 9 in.; pp. 315. $2.50.

After nine short chapters on franchise principles, capital risks, etc., and a single general chapter on "Existing Plans," the remainder of the book is devoted to a topical analysis of service-at-cost plans in effect and proposed.

SUPPORTING STRENGTH OF DRAIN TILE AND SEWER PIPE UNDER DIFFERENT PIPE-LAYING CONDITIONS—By W. J. Schlick, Drainage Engineer, Ames, Iowa: Engineering Experiment Station of the Iowa State College of Agriculture and Mechanic Arts. Paper; 6 x 9 in.; pp. 68; illustrated.

A review of tests made in 1915, 1916 and 1917. The tests were undertaken, primarily, to determine by actual tests the relation of the "ordinary supporting strength" as given by standard laboratory tests to the supporting strengths developed by pipe under "ordinary" pipe-laying conditions, to determine the definite ratios thereto of the supporting strengths developed with other pipe-laying methods and to determine the most economical methods of increasing the supporting strengths of pipe, through better and more careful methods of laying, under different ditch conditions.

TEXT-BOOK OF THE MATERIALS OF ENGINEERING—By Herbert F. Moore, Research Professor of Engineering Materials, Engineering Experiment Station, University, of Illinois, Member American Society for Testing Materials; with a Chapter on Concrete by Harrison F. Gonnerman, Research Assistant Professor in Theoretical and Applied Mechanics, Engineering Experiment Station, University of Illinois, Member American Society for Testing Materials, Member American Concrete Institute. New York and London: McGraw-Hill Book Co., Inc. Paper; 6 x 9 in.; pp. 315; illustrated. $3.

A second edition. New matter is mainly in the chapter on Concrete, by H. F. Gonnerman, which contains an admirable résumé of the current proportioning theories. Some question might be raised as to the permanence of those theories and the desirability of dignifying them yet in book literature.

THE TIDES AND TIDAL STREAMS: With Illustrative Examples from Canadian Waters—By Bell Dawson, M.A., D.Sc., M. Inst. C.E., F.R.S.C., Superintendent of Tidal Surveys. Ottawa, Can.: Dept. of the Naval Service. Paper; 7 x 10 in.; pp. 43; illustrated.

WATER AND SEWAGE PURIFICATION—By Sir Alexander C. Houston, K.B.E., C.V.O., M.B., D.Sc., Director of Water Examinations, Metropolitan Water Board, London. Reprinted from the Reports of the Progress of Applied Chemistry, Vol. 4, 1919. London: The Author. Paper; 6 x 9 in.; pp. 24; illustrated.

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LETTERS TO THE EDITOR

The Professional Spirit in Education

Sir—Inspiration to the individual is the thing which each educator is seeking. How "to get it across," how to awaken an impelling force in the mind of the student is the great problem. In each person there is a more or less latent motive or desire to achieve something; but this desire being unknown and unformulated, even to the consciousness of that person, the motivation may not take place until the eleventh hour—if ever!

Charles R. Mann, in his article in *Engineering News-Record* of June 24 (p. 1242), calls attention to the power of the World War in inspiring men to supreme effort and in bringing out the spirit of service and of sacrifice, existing everywhere, but overlaid by the "crust of the commonplace." He asks what is the thing which may become "the moral equivalent of war," effective to arouse our students? He answers in effect that it is the spirit of service, not self seeking, but service for the public welfare.

In this presentation Dr. Mann has put into words the underlying principles which have been the source of strength of the rapidly growing American Association of Engineers and which are needed in engineering schools. The A.A.E. is making a practical demonstration of these principles so well outlined by Dr. Mann. The association is growing largely because it is inspiring individual engineers everywhere with the spirit of service and of sacrifice for the common good. To the degree that it touches and quickens this spirit, to that extent it flourishes. Where, on the contrary, there is little or none of this spirit, it languishes.

In the engineering schools the American Association of Engineers is doing missionary or inspirational work such as outlined by Dr. Mann. This is attempted in the hope of arousing or keeping alive, in the midst of the distracting technical details, this all important thought that the true engineer "builds for people, not for individual." It is doing this by creating student chapters, all inclusive, bringing together every kind and class of engineering student. It is urging these chapters to take up, not the technical details of the class room, but the larger view of human relations, the duty and opportunity of the young engineer in the so-called "spiritual" or ideal, as contrasted with the purely material, objects embodied in the usual curriculum. It is trying to inculcate by repeated and tireless effort and by approach from every direction, this principle so well stated by Dr. Mann that "a technical school surely does not realize its true destiny when it is merely a factory for quantity production of standardized, technical and intellectual skill."

The student chapter primarily promotes acquaintance. It is about the only force which brings together seniors and freshmen, civils and mechanicals, as fellow workers in the public welfare. It gives opportunity for the exceptional man to demonstrate leadership and to do something immediate and tangible for the student body which, for the time, takes the place of larger public service. It offers to each eager student something of opportunity for the "great adventure", for trying out his mental alertness, his ability to think and express his thought not under the compulsion of the class room but in the democratic atmosphere of a self governing body, free to act and to accept or reject any proposition on the merits as presented by its proponents.

Here, if anywhere, is the agency to which we educators must look for the upbuilding of character—for the development of the force which offsets the tendency of the schools "to inspire the individual to make the most of himself for the sake of his *own* success," and to give the inspiration to the spirit of service for the public good, the spirit whose manifestation cannot fail to bring the largest measure of true success. For, as so well brought out by Dr. Mann in his conclusion, "All are ready to do (the engineer) honor and grant him credit for public service well done."

Urbana, Ill. F. H. NEWELL,
Professor of Civil Engineering, University of Illinois.

Sir—Dr. Mann, in his article appearing in *Engineering News-Record* June 24, p. 1242, considers an important subject, and one which faculties of leading schools of engineering have had in mind for some time. Many have gone so far as to do what Dr. Mann suggests to the extent possible in a four-year college course following only high school preparation. A good many years ago students of the Rensselaer Polytechnic Institute were discussing in their senior theses just such problems of sanitation and transportation as Dr. Mann suggests, and for many years the seniors of the College of Applied Science of the State University of Iowa have been doing this same thing.

The engineering schools have been criticized a good deal for the narrowness of their curriculums, and for the failure of their graduates to get into positions of leadership in industry and public welfare movements. Doubtless the training has been somewhat narrow, emphasizing more the trade of engineering than the profession of engineering. But one wonders somewhat whether this criticism is wholly well founded. The engineering schools like others have been growing—as new visions are seen, new methods and curriculums are adopted. The perfect has not been attained, but growth has been apparent and is even now in evidence in a decided movement toward greater generalization, with greater emphasis on the fundamentals of all engineering rather than on specialization in the work of a single branch.

Formerly it was quite customary for the engineering schools to have two of the four college years alike for all engineering students. Then, as the branches became more and more differentiated by the increase in knowledge and devices, the two years dropped to one, and then to none, and at least one strong school differentiated even between the various branches of what is generally classed as civil engineering, offering specialization in structural, sanitary, railway, and geodetic engineering.

Now the movement is backward, as engineering practitioners are telling the schools *to train in fundamental principles.* As one great industry says, "We don't care whether your men graduate as civil engineer, structural engineer, or mechanical engineer; if they have been trained in the fundamentals, they can learn our business." So two years ago the College of Applied Science of the State University of Iowa adopted the plan of differentiating between its courses in civil, electrical, and mechanical engineering only in the fourth year, and then only to the extent of about two-thirds of the work of that year. Other schools are following this lead. The College of Applied Science would not differentiate in the fourth year if it did not feel called upon to continue a school of engineering which can't be done without students who, in the presently existing attitude of mind, demand to be trained as civil engineers or mechanical engineers or electrical engineers, or in some other definitely classified branch of the profession.

Just at this time engineering schools are in a situation not wholly without unfortunate possibilities. As was brought out by Prof. J. H. Dunlap at the recent convention of the Society for the Promotion of Engineering Education, twenty years ago in the matter of entrance requirements engineering schools stood at the top of the group of professional schools including law, medicine, dentistry and engineering. Now they stand at the bottom.

With the better schools of medicine requiring from six to seven years work after high school, two of which is in training in letters; with law schools requiring two years of work in letters and arts for entrance; and with dentistry schools requiring one or two years of such work for entrance, there would seem to be great danger that these professional schools will draw the cream of the young men looking to a professional career, leaving the overflow to the engineering schools.

Broader training? Yes, but how much broader in four years? There is so much now of fundamental technology that is essential to the training of the engineer who would have breadth of technical training, that training in the humanities, so-called, must be added at the top or bottom, or possibly strung along ribbon-fashion as proposed at Michigan. But however given it means more years.

breadth of training requires time. The national societies, if they will, can compel engineering schools to take the time, just as the American Medical Society has demanded of the schools of medicine.

Do the industries employing engineering graduates and the older practising engineers want breadth of training? The engineering schools will give it if they are backed in their efforts by the profession.

Iowa City. WILLIAM G. RAYMOND,
Dean, College of Applied Science, State University of Iowa.

Sir—Dr. Mann in his article "The Professional Spirit in Engineering Education," *Engineering News-Record*, June 24, 1920, brings to life an old idea at a moment we all hope may be propitious. It is timely, not only for the reasons given, but also because engineering colleges generally are engaged in revising their curricula the better to meet modern conditions.

Even before the war teachers of engineering subjects were realizing the necessity of changes. It is interesting and significant that these changes contemplated a more liberal education for the engineer. It was realized that the trend during the past thirty years had been too much toward the technical. We were developing technicians rather than engineers; that is, our instruction was narrowing rather than broadening.

Dr. Mann hits the nail on the head when he says: "The required training must inspire the individual to make the most of himself for the common good." And he touches a sore spot in saying "relatively few of the graduates of engineering schools win recognition as professional men." Why? In part, at least, because the modern graduate is a technician rather than an engineer.

A further answer may be found in the engineer of fifty years ago. They won recognition—became world known. Why? All the engineering books they studied could be carried under one arm—a half dozen at most. Now there are wheel-barrow loads of them, but no wheel-barrows. To fill out his course the older engineering student had to take a good part of the college literary courses. He studied dozens of non-technical subjects and came out of college with an outlook upon his career quite different from the graduate of today.

The fact that the engineer of today must have knowledge of technical subjects unknown in earlier days, and the further fact that his course of study is still four years, explains why his vision is fore-shortened. The obvious answer is a longer course—five years or even six. We must come to it as soon as practicable if we would put the engineer in position to "win recognition as professional men." At least, so I think. M. E. COOLEY,

Dean Colleges of Engineering and Architecture,
Ann Arbor. University of Michigan.

A Tribute to General Gorgas

Sir—With the passing of Gen. William C. Gorgas earth is the poorer in its loss of him, but in his life humanity is the richer for his unceasing activity in the alleviation of suffering and the advancement of those things which make for the best in life—service to mankind. The record of his work at Havana, at Panama, at Johannesburg and lately at Peru, is well written in enduring history. Never spectacular, never self-assertive, never jealous of his own fame or fearful of allowing credit to others Dr. Gorgas attained distinction which easily placed him pre-eminent among the builders of the Panama Canal.

Not of engineering education, but a great engineer in the true sense of the word. By his devotion to duty, his confidence in the right and untiring service in face of natural difficulties and personal humiliation General Gorgas made possible that condition which allowed the United States to undertake and complete the colossal work which had been a dream for centuries, but a failure in accomplishment to the time of his coming. However great the engineering feats accomplished, for centuries this canal had been thought of, its plans had been made, its work had been begun and there was no lack of money for its accomplishment. The sole reason for its delay and previous failure to proceed was lack of human help to do the work, and that lack was caused by the inability of men to live on the disease ridden Isthmus. The problem of help was solved and the remedy applied by the work of General Gorgas in banishing yellow fever, not only from the Isthmus, but from neighboring infected ports, and safeguarding the health of workmen against malaria and other disease of tropical lands. With yellow fever gone and malaria under control nothing remained but to go ahead without fear and do the work. General Gorgas made possible the building of the Panama Canal and to him the United States owes its prestige in the completion of the work.

Personally General Gorgas was a most kindly and gracious gentleman in everything that word means; true, loyal, steadfast in duty and without reproach, he had what so many men in high position fail to achieve—the wholehearted loyalty of his staff of helpers. This attribute of binding to himself staunch and friendly co-workers brought to Dr. Gorgas, without striving for it, that which more ability could not attain but which coupled to his ability gave to him international prestige.

Perhaps General Gorgas' most notable characteristic was his readiness to give credit, and his willingness to consider plans of others. Never arbitrary, never vindictive, unconsciously he attained position eagerly sought by others and missed. The work accomplished by him is written for enduring fame, well recognized by his contemporaries and sure of even brighter recognition as the result of his well-laid plans worked out to maturity.

General Gorgas seemed beset with his desire to overcome pestilence and disease, not content with the laurels so well deserved which were his for work well done, and of quantity and quality that well might satisfy an ordinary man; at the time of his death it is understood that he was planning even a more far-reaching health crusade. With his past record there is no doubt but that he would have gone far in its accomplishment. So I say earth is the poorer for his passing.

Naturally great hearted, courteous and thoughtful for others, ever ready to help, ever ready to serve, there are all too few of his kind for us to spare, but even "as ships that pass in the night and speak to each other in passing" so with us who had the privilege of knowing Dr. Gorgas personally, while there is a sense of loss in his going, our own lives are the richer for the contact and cheer from one of earth's noblemen. CALEB MILLS SAVILLE.

Hartford, Conn.

Shrinkage of Loosely Filled Earthwork in Embankments

Sir—In *Engineering News-Record* of June 24, Mr. E. E. R. Tratman has called the attention of engineers to the much vexed question of the shrinkage of the earth in embankments. I think it is more a question of words than of facts, the controversy arising upon the terms of the question, and because of the attempt to establish a relation between two facts which are entirely independent of each other. The Illinois Public Utilities Commission would have reached different conclusions if the case had been presented in a more proper form.

The engineer of the Commission who made his conclusions according to my position on the question, regrets that I based my opinion upon abstract reasoning and not upon experimental data; and Mr. Tratman says that I made statements, but failed to give evidence in support of my view. A word of explanation will not be out of place and it will invite discussion.

The complex question of the shrinkage of earth is greatly simplified when examined under two distinct points of view, viz., the removal of the earth from its natural position, and then when it has been deposited in the embankment.

Concerning the first part of the question, everyone agrees that the earth removed from its natural position increases in volume, or swells, as it is commonly called. As there is common consent on this point, any further discussion will be

useless. It will be convenient, however, to remember that the bulging or swelling of the earth, is caused by destroying the cohesive force which holds together all the different particles; these being now loosened, there are an infinite number of voids between them, and it is these voids which cause the increase of volume of the earth after removal as compared with its volume in its original place.

Now, if the earth after it has been removed from the natural bank (and consequently of larger volume) is deposited in such a way so as to form an embankment, this will be found of a larger volume than the original cut. Theory teaches that the cohesive force of the material once destroyed is never resumed to the same former intensity; which means that the particles of earth in the embankment will never be so compact as they were in the material in its original position, and since voids will always exist in the embankment, thus the embankments will always be found of larger volume than the cuts from which they were taken. Such an assertion is not an abstract reasoning but it is based on facts and practical experience. It is an ascertained fact that it is easier to remove the earth from an embankment than from its natural position, which indicates a smaller cohesive force in the embankment, and the consequent presence of voids which are the real cause of the swelling. It may be concluded, therefore, that the earth deposited in the embankment will always occupy a larger volume than in its original position.

Engineers and trackmen know by experience that the earth in the embankments decreases continuously, and such a reduction of the volume is attributed to the shrinkage of the earth itself. The earth in a new embankment is in a very loose condition on account of the numerous voids existing between its different particles, and it will yield a great deal under the pressure of traffic and rain, such a subsidence is called the shrinkage and it is very sensitive in the green fills. The subsidence of the embankment will continue for a very long time, although in old embankments it will not be so apparent as in the new ones, and such a slow but continuous yielding is due to the fact that the cohesive force will never be restored to its former intensity. The earth in embankments may be compared to the piles which yield a great deal under the first blows of the hammer and their sinking under the successive blows will be less and less. Consequently the distinction between Settlement and Shrinkage as suggested by the engineer of the Illinois Public Utilities Commission does not seem to be correct as the embankment will settle continuously on account of the voids which in larger or smaller number will always exist between the various parts of the material. Here in New York we have a splendid example of the continuous subsidence of old fills. In front of the New York Library at 42nd Street, the earth has been deposited on the roof and sides of the Subway for over fifteen years, and the slabs forming the sidewalk alongside the Library have been edged off several times on account of the subsidence of the street. This continuous yielding cannot be explained except for the voids between the various particles of the earth, which are constantly reduced, thus compacting the fill more and more all the time. If such a subsidence is so noticeable in a restricted fill confined by the walls of the surrounding houses, the structure of the Subway, and covered with an almost impervious pavement, what will not happen in embankments exposed directly to the action of heavy traffic and atmospheric influences?

When the volume of the earth in an embankment is found less than the volume of the original cut, it does not mean that the earth itself had shrunk, but instead that all the quantity extracted from the cut is not found in the embankment. Portions of it might have been lost in transportation, but a larger part was carried away by rain, frost, wind, etc., and other causes which are not controllable and which cannot be converted into mathematical formulas. Hence any attempt to determine the amount of these losses in relation to the volume occupied by the earth in its natural position, would be too empirical and unpractical.

In conclusion, it can be said: 1st. That the earth in embankments will always be found of larger volume than in cuts. 2nd. That the earth does not shrink. 3rd. That the observed decrease in volume in the embankments as compared with the cuts, is caused by the material which has not been deposited in the embankment or it has been removed by atmospheric influences.

New York City. CHARLES PRELINI.

Drainage of Road Surfaces

Sir—On p. 33, your issue of July 1, is contained a synopsis of A. R. Hirst's paper "Earth, Clay and Sand Roads." This gives very valuable advice written from a practical standpoint.

There is one point, however, that does not seem to receive proper attention, and that is the matter of drainage of the road surface. The proper crowning, side ditches, etc., are always carefully considered. In flat countries, however, roads may have very deep ditches on each side but in wet weather wagons and automobiles cause longitudinal ruts, which become deeper and deeper, are always filled with water, and if the road material is of an impervious clayey nature cannot possibly drain into the side ditches, and soon the roadway becomes almost impassable. The obvious remedy, which does not seem to have received any attention whatever, is to produce artificially longitudinal grades of say 1 per cent. If the summits of these grades are 200 ft. apart the drainage can go in both directions and be taken care of by transverse prepared gravel or broken stone short sections at the hollows, which can drain into the side ditches. With this arrangement it is not difficult to keep the road bed in fairly good shape even in the worst weather, and the expense of making such a road is very little greater than if the road were made in the ordinary way.

J. W. LEDOUX,
Philadelphia, Pa. Consulting Engineer.

How Should Motor Vehicles Be Taxed to Supply Highway Funds?

Sir—In his article, "Motor Vehicle Instead of Gasoline Tax Probable in Great Britain" in *Engineering News-Record* July 1, p. 4, Mr. Mehren touches a topic which is very interesting and very important to the highway engineers of the country. It opens up a broad field for investigation.

I have long been of the opinion that some equitable method should be worked out whereby the motor vehicle owner or operator should pay a fair amount toward the improvement of highways. This amount should vary in proportion to the amount of use and the amount of damage done by the different classes of vehicles. It would sometimes appear that it may be even necessary in the future to establish weighing devices along the highways and collect a fixed charge per ton for the operation of trucks and other types of commercial vehicles.

One thing seems evident at the present time—that the motor vehicle licenses, particularly those of trucks, are not sufficiently high to take care of the upkeep of the highways.

One of the great troubles, of course, is that there is a comparatively small percentage of roads improved in this country as against the large percentage in Great Britain indicated by Mr. Mehren in his commendable article. In order that we may secure all possible revenue for the purpose of developing further highway systems to accommodate the constantly increasing traffic, it will be necessary to secure income from every possible source and of the greatest magnitude. The proportionate charge to each class of vehicle should be worked out on a fair basis; and co-operation between the motor vehicle manufacturer, highway engineer and the operator of the different types of vehicle should result in something of benefit not only to the highway systems of the country, but to the general public as well.

I shall be very glad to read any remarks made by other engineers on the question of motor vehicle taxes.

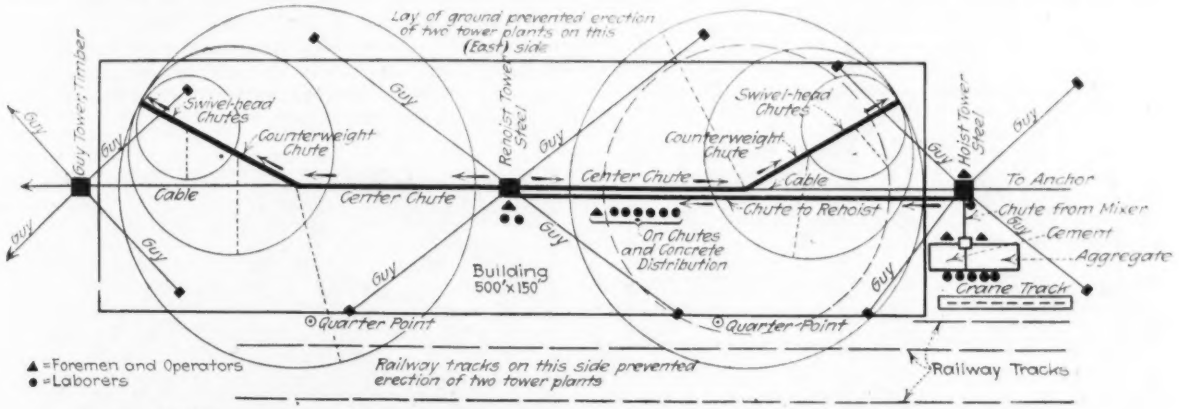
Hartford, Conn. C. J. BENNETT,
State Highway Commissioner of Connecticut.

HINTS FOR THE CONTRACTOR

Concrete Building Plant Plan—II

Tower and Rehoist Substituted for Two-Tower Plant

THE ground level and existing railway tracks prevented the nominally preferable arrangement of two tower-plants for concreting a 500 x 150-ft. four-story building at Kokomo, Ind., and a tower-plant and rehoist were substituted with successful results. As shown by the diagram plan, the building was rectangular and the nominally economical arrangement would be a tower-plant at each of the quarter points on one of the long sides. With a two plant arrangement, the erection cost would have been less, the operating expense smaller and the equipment cost about the same, in comparison with the plant layout adopted.



CONCRETE BUILDING PLANT LAYOUT WHERE SIDE TOWERS WERE IMPRACTICABLE

The only practicable location for the materials plant was at the south end over an old quarry which made necessary a trestle for the crane track as well as for the two-compartment bin. Bin storage provided for 270 cu.yd. of aggregate, and about 1,000 cu.yd. could be stock-piled between the crane track and the bins. Bulk cement was unloaded from gondola cars by clamshell into the 1,000-bbl. cement bin. The clamshell was ¾ cu.yd. and the mixer capacity was 30 cu.ft. The mixer chuted into the bucket of the hoist tower, which was of steel and 120 ft. high, and delivered the concrete to the foot of the rehoist tower 200 ft. high.

For direct delivery of concrete to lower floors of the south end of the building there was hung to the chute from hoist to rehoist a counterweight chute covering the circle shown by the dash line. Tripod-supported extension chutes served areas outside the circles.

With a crew of 19 men, as shown by the diagram, a rate of 295 cu.yd. of concrete in place in 9 hrs. was secured; the average output per 8-hr. day for the job was 200 cu.yd. Concrete work was begun July 28 and completed Nov. 1. Delays due to shortage of material were 4½ weeks, making an actual working period of 10½ weeks.

The building was constructed for the Haynes Automobile Co., by the M. J. Hoffman Construction Co., Indianapolis, Ind.

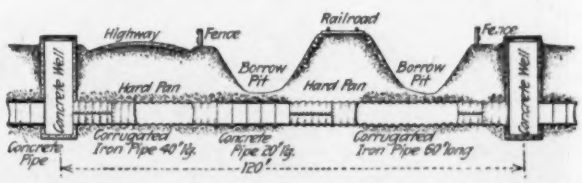
Pipe Jacked Under Railroad and Highway

JACKING a 30-in. corrugated-iron pipe 120 ft. in length underneath main line railroad tracks and the state highway in constructing a siphon in Stanislaus County, Cal., was a task recently accomplished by R. V. Meikle, chief engineer of the Turlock Irrigation District, according to a recent issue of *Highway Magazine*.

There was a layer of hardpan a few feet below the surface and the pipe had to be placed below that. Conditions demanded a thoroughly strong and watertight construction, yet it was deemed impracticable to disturb railroad and highway traffic by following the usual methods for such installations. Difficulty was added because considerable water had to be cared for during the installation.

Three weeks of preliminary work were necessary, work pits being dug at each side of the rights of way to allow room for the jacking operations. After the pumps were installed and the ditches had been dug up to the rights of way of highway and railroad, but a day and a half were consumed in the actual jacking operations. Traffic was interrupted little, trains slowing up as a precautionary measure for one day only.

Pipe lengths as received were coupled and riveted in the field to make one section 60 ft. long and another 40 ft. long. The 60-ft. length was first jacked into place and then the 40-ft. length was installed. A man worked inside of the culvert removing earth as the operations proceeded. While the operations were going forward it was found that an additional 20 ft. of pipe would be needed, so some concrete pipe on the job was put in as a middle section. This concrete pipe forms the only joint in the siphon.



CROSS-SECTIONAL VIEW OF INSTALLED SIPHON

The crew consisted of five men, operating a 50-ton jack, a clamshell dredger, one 2-in. and one 4-in. centrifugal pump, and a 2½-hp. gas engine.

Horse Cuts Truck-Loading Cost

By Dan Patch
Aberthaw Construction Co., Boston, Mass.

THE cost record on a job of the Aberthaw Construction Co. in Danville, Va., showed a high charge for unloading the first car-loads of reinforcing steel. The writer happened to be visiting the job and went over to the freight yard while waiting for his train, and pulled his watch on the unloading gang, making notes at the same time of the unloading operation on lumber.

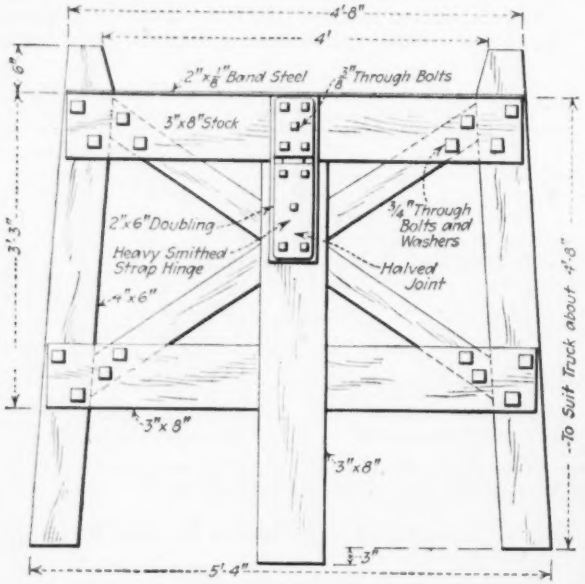


FIG. 1. DETAILS OF HORSE USED IN STEEL UNLOADING

The unloading was being done by 5-ton trucks with trailers, one unloading gang and two trucks working. The time for loading one truck was about equal to the time necessary for a round trip to the job. This meant that each truck was idle about one-half of the time. As trucks are high priced equipment it was easy to see why there was a high cost for trucking the steel.

On arriving at the home office, the writer made a rough sketch of a horse which he suggested might be used to release one of the trucks working on steel. Fig. 1 shows the horse as made up by the job mill carpenters.

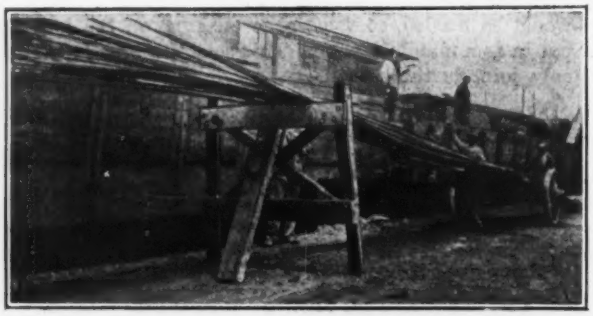


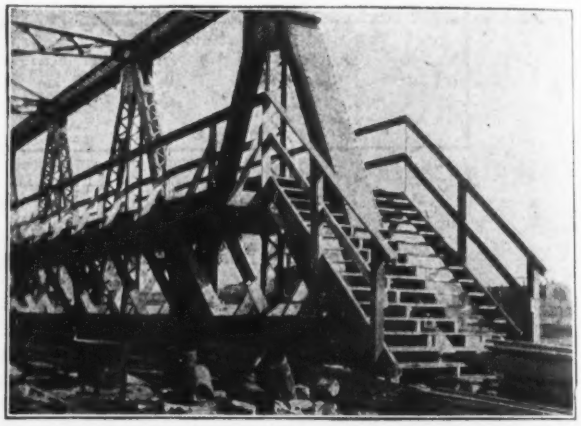
FIG. 2. READY FOR THE TRUCK

Fig. 2 shows the steel unloaded over the trailer and horse and ready for the truck to back under the load.

This gadget allows one truck to do the work of two and allows the unloading gang to unload steel after the truck has left on its last trip at night, or before the truck arrives in the morning. The cost of the horse was about one-half of one day's cost of a truck and driver.

Temporary Footway Built on Viaduct Under Construction

PEDESTRIAN traffic across the Abbott Road Viaduct over the railway yards at Buffalo, N. Y., is so heavy that in the recent reconstruction of the viaduct it was felt to be necessary to provide some footway during the interval between the taking down of the old trusses and the completion of the new floor system. Some 4,000 people cross the bridge each day and detours are not convenient nor use of the tracks themselves safe. As an expedient, therefore, a temporary wood sidewalk was built half way up one of the new trusses, as shown in the view. There was a period of 10 days only in which a crossing was not available.



The footway consists of inverted A-frame bents spaced about 7 ft. c. to c. with 2-in. yellow pine decks nailed to horizontal floor-beams, thus providing a double sidewalk about 3 ft. 9 in. clear width on each side of the web members of the south truss of each span of bridge. The inverted A-frames as well as the end stairways and floor-beams are 2 x 10 in. yellow pine and railing and posts are constructed of merchantable sizes and lengths of lumber. The frame connections are bolted with ½-in. bolts and the railing and braces are nailed with 20 d. nails, clinched. The footway was carried at a height of 9 ft. 6 in. above the floor beams of viaduct to permit the operation of a traveling "horse" which carried a hoist for erection of cast-iron protection plates to be attached to the bottom of the structure over the tracks.

The viaduct is being constructed for the City of Buffalo by the American Bridge Co., F. K. Wright, resident engineer and the sidewalk was erected by Alvin F. Goehle, under the direction of Frank D. Jackson, assistant engineer, Bureau of Engineering. The cost of the sidewalk was $6 per lineal foot and much of the material can be recovered or used on other structures which will be reconstructed in the near future.

NEWS OF THE WEEK

New York, July 15, 1920

Construction Throttled by Car Priority Order

Material Men Object to Wholesale Allotment of Transportation to Coal Interests by Interstate Commerce Commission

Despite earnest pleas on the part of those interested in building construction, road building and other enterprises, it seems evident that the Interstate Commerce Commission is unwilling to modify its service order No. 7, which gives priority in the use of open-top cars to coal mines. This view of the commission's attitude is formed from the questions asked and comment indulged in during the recent hearing on the supply, exchange, interchange and return of open-top equipment. A typical argument against the present basis of allotting railroad cars was that of A. N. Johnson, representing the Portland Cement Association. Extracts from his argument follow:

"Since November, 1918, the construction industry, second only to agriculture, has been continuously handicapped. Governmental restrictions, increased cost, labor shortage, production shortage, lack of transportation facilities, have all combined to prevent construction enterprises. The construction industry is basic. Whatever tends to curtail this industry is certain of far-reaching effect and if carried much further must result in great industrial depression.

"The situation is rendered all the more serious as in the past three years there has been a marked deficiency of completed structures. During this time the demand and the need have been increasingly urgent for all classes of buildings, farm structures, roads and railroad construction. There is a deficiency today of not less than one million homes. At the present time there are actually available for highway construction over $700,000,000, money that cannot be used for other purposes. These roads, if constructed, will be of great help in lessening railroad terminal congestion.

"It is recognized that terminal congestion plays a far larger part in the present difficulties of the railroads than the moving of business over the roads out on the lines. Much of the terminal congestion results from the short-haul shipment of necessary food products for the daily subsistence of the people living in our large cities. Therefore not the least among the structures for which need is most pressing are improved roads, in order that motor trucks operating over such roads may

(Continued on p. 142)

City Manager for Colorado Springs

The city manager form of government, effective next April, was adopted by Colorado Springs at a popular election held July 6.

Milwaukee Filters of 160 Million Gallon Capacity Recommended

Following investigations of the water problem in Milwaukee for a year, J. W. Ellms, consulting engineer, Cleveland, has recommended the construction of a 160,000,000-gal. daily rapid filter plant. This action is taken, he states, in a printed report of 156 pages, "in view of the present polluted condition of the city's water supply, and the probable continuance of dangerous contamination, even if the best methods now known are used to dispose of the sewage of the city."

The proposed plant, which is to be located on the lake front near the shore shaft of the Linwood Ave. intake tunnel, will take advantage of the following information obtained from the experimental work: That adequate mixing of coagulants with the water may be obtained in comparatively cheap and simple devices, such as a flume with a "hydraulic jump" at the end; that a sedimentation period of not less than three hours nor more than four hours is necessary; that the effective size of the sand be between 0.35 and 0.40 m.m.; that conduits and pipe lines be provided of such size that rates of filtration of from 15,000,000 to 20,000,000-gal. daily in excess of the normal rate may be utilized. Chlorine disinfection is approved as the "second line of defense" against contamination. Ozone apparatus was found not to be developed sufficiently so it can compete in cost with chlorine.

Estimated costs are as follows: Protection wall for site and for fill back of wall, $382,700; foundations, $867,440; coagulation basins, mixing flume and discharge conduits, $782,000; filter tanks, piping, valves, gates, filter equipment and filtered water reservoir, $1,500,000; chemical house, wash water tank and low service pumping station, $448,000; contingencies and engineering, 15 per cent, $600,000; total $4,580,140. For operation and maintenance Mr. Ellms estimates the cost per million gallons at $5 to $6 and the fixed charges at as much more.

Henry P. Bohmann is superintendent of water-works and water purification. Ernest F. Badger, was the principal chemist and bacteriologist who carried out the investigation under Mr. Ellms' direction.

Dallas Club First Local to Join Federation

Joint Conference Committee Reports Action by Local and National Societies Following Organizing Conference

The first application on the part of a local engineering society for membership in the Federated American Engineering Societies has been made by the Technical Club of Dallas, Texas, which voted at a meeting June 22 to join the new body created at the Organizing Conference held in Washington, D. C., June 3-4. This news is contained in a bulletin which has just been issued by the Joint Conference Committee, representing the four founder societies, and which sums up the action thus far taken by various national and local organizations with respect to membership in the new federation. Extracts from the bulletin follow:

At the annual meeting of the American Institute of Chemical Engineers held in Montreal June 28-July 3, the question of the Institute becoming a member of the Federated American Engineering Societies was favorably discussed and referred to the Council for consideration at its meeting on July 25, at which time definite action will be taken. In the discussion it was stated that the Institute should be a member of this organization and, if its finances would not permit, the members should be assessed the necessary amount.

The report of the delegates to the Organizing Conference was read at the meeting of the Board of Direction of The American Institute of Electrical Engineers at the annual convention at White Sulphur Springs, W. Va., June 30 and the following resolution adopted:

RESOLVED, that it is the sense of this board that the A.I.E.E. should join the Federated American Engineering Societies but that as there is a small attendance at this meeting and a new board will be constituted commencing with the administrative year on Aug. 1, action be deferred until the August meeting of the board and that a letter be sent the members of the incoming board, with a request that they give careful consideration to the matter and be prepared to act at the next meeting.

The report of the delegates to the Organizing Conference was read at the meeting of the Board of Direction of the American Institute of Mining and Metallurgical Engineers June 25, was favorably discussed and referred to the Finance Committee to devise and report on means for meeting the financial requirements.

The report of the delegates to the Washington conference representing the American Society of Civil Engi-

neers will be presented at the annual convention of that society, at Portland, Oregon, August 10-12.

REPLIES TO CRITICS

To critics of the plan for the Federated American Engineering Societies the Joint Conference Committee makes the following reply:

"In the aftermath of the Washington Conference there has been considerable discussion of the new organization and a number of incorrect statements have been made. One of these is that 'during the war, technical men observed the fact that many engineering problems required the joint action of the technical societies. This requirement was met by the formation of Engineering Council. Now the Organizing Conference proposes a new organization.' This is not correct, as it has been repeatedly pointed out that the work of The Federated American Engineering Societies will be administered by the American Engineering Council which will succeed the present Engineering Council. This procedure received the approval of Engineering Council at its meeting on October 16, 1919, when it endorsed the 'general plan for a national engineering council as outlined by the Joint Conference Committee of the Founder Societies.'

"It has also been suggested that 'no specific business is as yet outlined for action by the Council' that 'the federated societies is so completely nebulous that one cannot commend or condemn it and it will be some time before the new organization will begin to function.' As a matter of fact the Organizing Conference, at the closing session on June 4, adopted the following resolution:"

RESOLVED, That it is the sense of this Organizing Conference that the Joint Conference Committee should be entrusted with making provision for putting the conclusions of this conference into effect and that Engineering Council be requested to carry on its work until the new organization has been established, and by all proper means to further the program of the new organization. The Conference further recommends to the contributing societies that they continue supplying the funds required by Engineering Council until its work is taken over by the new organization.

Engineering Council at its meeting June 17, unanimously adopted resolutions endorsing the federation. (See July 1 issue, p. 43.)

ENGINEERING COUNCIL CO-OPERATES

The action of Engineering Council in accepting the invitation of the Organizing Conference, the Joint Conference Committee points out, means that the activities of Engineering Council which are those to be undertaken by The Federated American Engineering Societies, will be continued without interruption, until the American Engineering Council is prepared to take up the work.

The statement that this new organization "is completely nebulous" cannot, according to the committee, stand against the fact that the Organizing Conference in Washington adopted a complete constitution and by-laws to govern the organization which came into existence when The American Society of Mechanical Engineers applied for membership immediately following their adoption, and at which time assurances were given that the Detroit Engineering Society and the American Institute of Electrical Engineers had taken, or would take, similar action. To this nucleus must be added the Technical Club of Dallas so that the Federated American Engineering Societies has come into existence and the first meeting of its governing body will be held probably in November of this year.

PURPOSE OF FEDERATION

The committee concludes its bulletin with the following statement:

"There seems also to be confusion as to the purpose of the new organization as set forth in the constitution:

The object of this organization shall be to further the public welfare whenever technical knowledge and engineering experience are involved and to consider and act upon matters of common concern to the engineering and allied technical professions.

"The organization is to deal with what are commonly known as welfare or non-technical matters. It is not a social organization; it is not an organization of individual members. As its title indicates it is a federation of societies with whose autonomy and activities it in no way interferes. It does not create a new organization but it will succeed the present Engineering Council and will be more comprehensive as to scope and membership.

"The Federated American Engineering Societies will not in any sense be a competitor of any existing organization. Its success will depend upon the whole-hearted support given by the individual engineers and allied technologists of this country through the respective engineering and allied technical societies with which they are identified."

California Seeks Highway Survey By Bureau of Public Roads

As a result of recent charges brought against the commission and in order to secure impartial judgment upon the efficiency of its highway system, the California Highway Commission has requested the U. S. Bureau of Public Roads to study and report upon the state highway system. The commission believes that an authoritative, impartial and comprehensive report upon California work, which to date has cost approximately $33,000,000 and has given 2,500 mi. of improved roads consuming nine years to construct, would be of great interest and value not alone to California but to other states as well. The commission anticipates favorable action by the Bureau of Public Roads upon its request. It is expected that the investigation will require several months, and that it will cover location, engineering, type, permanency, surfacing, and economic value.

Sewage-Works Contract Abandoned by Contractor

The contractor for building the northeast sewage-works at Philadelphia has declined to proceed with his contract and his operating plant has been taken over by the city through the action of Joseph C. Wagner, acting director of public works, and George S. Webster, Chief of the Bureau of Surveys. The contract price was $1,025,000. The contractor supplied the bond for $512,500 through the National Surety Co. of New York. The work is about 35% completed. A greater part of the excavation has been made and a small percentage of concrete and re-inforcing steel placed.

Work Resumed on Chippawa Canal

Work was resumed on the Chippawa Canal around Niagara Falls on July 8. The Hydro-Electric Commission of Ontario agreed to establish the 8-hour day in the machine shops, the rest of the work to be on a 10-hour basis. About 800 men of a normal staff of 2,000 returned and others are expected to do so shortly, but a large proportion of the employees have left the district.

Motor Vehicles in Pennsylvania Show Increase

The Automobile Division of the Pennsylvania State Highway Department has predicted that more than 525,000 licenses will be issued in 1920 for pneumatic tired vehicles. Tag No. 469,000 was issued last week. The total number of licenses issued for pneumatic tired vehicles in 1919 was 441,224.

Truck registrations also show a great increase over 1919. The number of licenses issued up to July 9 for solid tired vehicles totaled 41,556. The 1919 total was 40,893.

Up to July 8, the total receipts from automobile registrations were $7,176,761.47. This is an increase over the total receipts for 1919 of $1,086,115.78.

The Automobile Division has received a number of requests for tag No. 500,000. It is expected that this number will be reached early in August.

The total registrations of pneumatic tired vehicles for the last six years were as follows: 104,950 in 1914, 152,365 in 1915, 218,846 in 1916, 306,001 in 1917, 363,001 in 1918, 441,224 in 1919.

Arizona Engineers Name Five Road Commissioners

Five men were recently recommended by the Tucson Chapter of the American Association of Engineers to act as highway commissioners of Pima County. These recommendations were made at the request of the county board of supervisors. The engineers so recommended have been appointed and placed in charge of an expenditure of nearly $2,000,000 on the location and construction of new roads. The commission has already employed more than 60 engineers.

Colonel Kelly Engineer-Officer With Power Commission

Lieutenant-Colonel William Kelly, Corps of Engineers, U. S. A., has been appointed by the President on the recommendation of Major-General Beach, Chief of Engineers, to serve on the Federal Power Commission as engineer-officer. Much of Colonel Kelly's experience in the Corps of Engineers has been in California, where he has been brought in contact with water-power problems. He was in command of the 117th Engineers in France and later became chief engineer of the Fourth Army Corps. From that post he was promoted to base commanding officer. More recently he has been stationed in Washington.

Retirement Pensions Provided for Government Employees

By virtue of an act of Congress signed by the President May 22, 1920, all employees in the classified civil service of the United States will after the 1st of September of this year become participants in a retirement annuity scheme. This includes, of course, a great number of engineers in the public service.

The scheme which is to be put in effect after a number of years of persistent agitation on the part of the government employees at Washington is only partly a pension scheme, inasmuch as the recipients will have to contribute each year to the annuity fund 2½ per cent of their salaries. The annuities, however, commence immediately so that all those who have served the requisite number of years will begin to receive their annuities as their terms of service reach the required period, regardless of the amount they have paid toward the annuity.

The law provides that all who have three months after the passage of the act reached the age of seventy years or shall have reached that age on any date thereafter and rendered at least fifteen years of service to the government shall be eligible for retirement on an annuity, and provides that mechanics, city and rural letter carriers, post-office clerks shall be eligible for retirement at sixty-five years of age and railway postal clerks at sixty-two if they have rendered at least fifteen years of service. The employees are divided into six classes, depending upon their periods of service. Thirty years of service entitles the recipient to not more than $720 and not less than $360 per annum, or 60 per cent of the annual salary; Class B, those who have served at least twenty-seven years, 54 per cent of salary, or not more than $648 and not less than $324; Class C, those who have served not more than twenty-four years, 48 per cent of salary, or not more than $578 and not less than $288; Class D, not more than twenty-one years, 42 per cent of salary, or not more than $504 and not less than $252; Class E, a period of eighteen years or more, 36 per cent, or not more than $432 and not less than $216, and Class F, a total period of fifteen years or more, 30 per cent or not more than $360 and not less than $180. If the employee retires from the service before the prescribed age or period of service, he will receive back from the Government his 2½ per cent payments plus 4 per cent interest compounded once a year and the same amount will be diverted to his heirs in case of death.

General Marshall Dies

Brigadier-General William L. Marshall, U. S. A., Chief of Engineers from 1908 to 1910, died at Washington, D. C., July 2. He was born in Washington, Ky., 1846, and was graduated from the U. S. Military Academy in 1868. Among the important works constructed under his direction were levees in Mississippi, Louisiana and Arkansas, harbor improvements on Lake Michigan, improvement of the Mississippi, Chicago, Illinois, Rock, Fox and Wisconsin Rivers, and the Hennepin Canal. From 1900 to 1908 he was engineer in charge of the construction of fortifications at the eastern and southern entrances to New York harbor and improved the main channels of the harbor, constructing a new 40-ft. channel, known as the Ambrose Channel, at its entrance. He was appointed Chief of Engineers, U. S. A., July 2, 1908, and was retired June 11, 1910, when he became consulting engineer to the Secretary of the Interior, a position which he occupied until a few months ago, when he tendered his resignation on account of ill health. General Marshall was the discoverer in 1873 of the Marshall Pass across the Rocky Mountains, while in charge of the Colorado section of explorations west of the 100th meridian. In 1914-15 he was in charge of the protection of the Imperial Valley, Cal., against overflow of the Colorado River, at which time he was a member of the central board of review of reclamation project costs. He was also the inventor of automatic movable dams, lock gates and valves.

BRIG.-GEN. W. L. MARSHALL

Waterways Service in War Department

Pursuant to the new Transportation Act, Secretary of War Baker has established a new branch of the War Department to be known as the Inland and Coastwise Waterways Service, with Brig.-Gen. Frank T. Hines as chief of that service. The new bureau will have charge of the inland waterway administration delegated to the Government as a hold-over from the war activities of the Railroad Administration.

University of Washington Building Concrete Athletic Stadium

Considerable excavation has been done and concrete pouring is scheduled to commence soon upon the new concrete stadium being built for the University of Washington by the Puget Sound Bridge & Dredging Co., formerly Lewis, Wiley & Morse.

The stadium will have a seating capacity of 55,000 and will be built entirely of reinforced concrete. Excavation and fill of the 125,000 cu.yd. of material to be moved will be handled hydraulically. The playing field is at an elevation of 25 ft. and practically half of the seating capacity will be provided on reinforced-concrete seats set upon this hydraulic fill. Above a berm, 150 ft. wide on the top, and whose top elevation is 60, the superstructure of the stadium will rise. The extreme dimensions of the stadium will be: For the interior, 308 x 487 ft.; exterior, 644 x 660 ft. It is to be built with one end open admitting future extension. On the outside of the stadium a 30-ft. plaza will be provided on both sides, widened to 150 ft. on the closed end.

Concrete steps placed directly on the fill will have a rise of 15 in. and a thread of 30 in., 3½ in. thick on the horizontal and 4½ in. thick on the risers. In the superstructure, however, though the concrete steps will have the same rise and thread, the risers will be thickened to 5 in.

The feature of construction will be the method used in building up the berm and the concrete steps resting upon it. Sheerboards, used to build up the berm in successive steps, will be so carefully placed as to line and grade that they will not only serve as bulkheads in hydraulic fill work, but also as inner forms for concreting the steps.

Money for the construction of the stadium was made available through profits from associated student activities and through the sale of bronze souvenir plaques entitling holders to reserve-seat privileges for periods of from two to five years at every baseball or football game, fete, pageant, military or naval affair, or public gathering. These plaques sold at $25 and $50 each for the two-year free admissions, and $50 and $100 for the five-year admissions depending upon the distance from Seattle the subscriber lived. The money was raised in a week's state-wide campaign. It is expected that the stadium will be completed in November.

Army to Report on Potomac Power Development

By special provision of the Federal Water Power Act, the Federal Power Commission is directed to report to Congress before Jan. 1, 1921, on the power development of the Great Falls of the Potomac, 18 miles above Washington. This project has been under study for many years and was particularly made the subject of a report by Col. W. C. Langfitt, Corps of Engineers, in 1913. Maj.-Gen. Lansing H. Beach, Chief of Engineers, has been charged by the Commission with the present investigation and has detailed Maj. Max C. Tyler, Corps of Engineers, to assist him in the work and to conduct any further surveys that may be necessary. A sum of $25,000 was provided by Congress for the report.

An earlier text of the water-power bill had an appropriation of $25,000,000 for the construction of a power plant at this site, but this was stricken out of the Act as passed.

Construction Throttled

(*Continued from p. 139*)

in taking over a greater share of short-haul traffic contribute in still greater degree to the relief of terminal congestion. Not only should new roads be built but those now in use must be maintained.

"It should be borne in mind that the results are more than the immediate suspension of construction projects, disastrous as they are. Contractors with equipment lying idle and deteriorating, organizations scattered, and expenses continuing, will of necessity have to recoup, and it will be the cause of a continued increase in prices. For every hazard which a contractor must shoulder, the public must pay an increased price. This is the insurance the contractors will demand. Therefore, there is seen the importance not only of some immediate relief but of the establishment of a policy that will remove as far as possible such transportation hazards as have been experienced this season.

"We all recognize there is a shortage of transportation facilities just as there is a shortage of many other essential factors in the industrial progress of the country. But arbitrarily to assign to any given group of shippers an undue share of the restricted facilities creates an unbalanced situation which threatens the whole industrial structure.

"In closing, we submit that to throw the entire burden and responsibility for carrying this burden, due to the shortage of transportation facilities, upon the construction industry is an unsound business policy, is unfair to the public and unjust to the contractors and material producers who now face financial ruin. And we ask that Order No. 7 be modified to correct these conditions and that a fixed policy be established that will prevent in the future priorities and discriminations against or in favor of any industry."

Road Studies To Include Vehicle Types

In addition to tests of impact, the U. S. Bureau of Public Roads has extended its experiments to include a study of the effects of different types of vehicles on road construction. First attention is to be given to the relative effects of solid and pneumatic tires.

Forest Products Laboratory To Celebrate July 22-23

The Forest Products Laboratory, Madison, Wis., which was organized by the United States Forest Service in 1909 and formally opened in June, 1910, will hold a decennial celebration July 22-23 at Madison in response to the thought of men acquainted with the work of the laboratory that it should receive a mark of recognition at this time in appreciation of its work during the last ten years. The two-day program will include addresses by prominent men associated with the industry, inspection of the laboratory, and educational features.

To Collect Data on Tonnage of Road-Building Materials

Close co-operation among the railroads, the U. S. Bureau of Public Roads and state highway officials is planned in order to prepare systematically for the transportation of road-building materials.

At present there are no figures available which indicate on a national basis the tonnage of road materials which are transported by rail. Figures will be gathered to show the number of cars which are required for this service; the numbers which are used for each class of material; the numbers used at each of the important loading points; and the various other facts which may be necessary to point out in detail the transportation requirements of the nation's road-building program.

One of the lessons of the present transportation difficulty, according to Thomas H. MacDonald, chief of the Bureau of Public Roads, is that it is not sufficient to leave to the individual contractors the matter of arranging their own transport. The Bureau expects to be helpful in that connection in the future.

New Committee To Study Problem of Roads and Vehicles

The relationship existing between the highway roadbed and the motive unit is to be the chief subject of study of a new committee established under the Department of the Interior. It is to be known as the Committee on Education for Highway Engineering and Highway Transport Engineering. On the committee are Thomas H. MacDonald, chief of the U. S. Bureau of Roads; Col. Mason M. Patrick, Corps of Engineers, U. S. Army; Roy D. Chapin, representing the automotive industry; H. S. Firestone, representing the tire and rubber industry; Prof. F. L. Bi[illegible] University of Pittsburgh, represent[illegible] the engineering schools; Paul D. S[illegible] gent, president of the American A[illegible] ciation of State Highway Officials; [illegible] Dr. W. C. Johns, of the U. S. Bureau [illegible] Education. Other matters which [illegible] be considered by the committee [illegible] include various important probl[illegible] pertaining to highway developm[illegible] The committee will submit recomm[illegible] dations for a more efficient and econo[illegible] ical administration of the highw[illegible] program.

PERSONAL NOTES

C. T. DIKE, assistant manager, at Omaha, of the Chicago & Northwestern lines west of the Missouri River, has been appointed engineer of maintenance, with headquarters at Chicago. He succeeds W. J. Towne.

D. ROUNSEVILLE, assistant engineer, has been appointed assistant chief engineer, at Chicago, of the Chicago & Northwestern lines.

THOMAS S. SCOTT has resigned the chair of civil engineering at Queens University, Kingston, Ont. He will be in Brockville, Ont., for the summer, directing road construction work in that locality.

J. F. DEEDS, of the U. S. Geological Survey, has been assigned to a study of the lower Musselshell River, in Montana, to determine the irrigability of lands along that stream.

IRVING E. MOULTROP, of Boston, has been elected by the trustees of the United Engineering Society, as a trustee of the American Society of Mechanical Engineers and a member of Engineering Foundation Board, to fill the vacancy caused by the death of E. Gybbon Spilsbury.

ALFRED MCKEE has been appointed engineer in charge of bridge construction for Polk County, Iowa, with office at Des Moines. Previously he was highway engineer for the county.

DELTA ENGINEERING CO. is the name of a new firm established at Greenville, Miss., by O. C. Kulicka and A. E. Boyte, for the practice of consulting and civil engineering.

PAUL P. TAYLOR, office engineer and assistant superintendent of the Kansas City Railway Co., has resigned to become city manager of Grand Haven, Mich.

N. B. GARVER, structural engineer, has been appointed consulting construction engineer for the Arkansas Division of the American Cotton Association, with headquarters at Little Rock. His first duties will be to make an investigation and report on the warehouse conditions in Arkansas, and to make recommendations with regard

the most economic types of construction, taking into account available materials, first cost, maintenance, insurance rates, etc.

P. V. ROSE, recently maintenance engineer of the Niagara Falls Power Co., has been elected president and manager of the Consolidated Fuel & Supply Corporation of Niagara Falls, N. Y.

ROBERT M. WATSON, assistant to the Secretary of Labor, has been appointed president of the United States Housing Corporation, to succeed Leroy K. Sherman, who has resigned to take up private work in Chicago.

JOSEPH S. BOGGS, commissioner of public roads, has been appointed state highway engineer of Kentucky.

DAVID M. EARLE, assistant city engineer, has been appointed city engineer of Worcester, Mass, to succeed Frederick A. McClure, resigned.

RALPH G. LINGLEY, assistant street commissioner, has been elected superintendent of sewers of Worcester, Mass., to fill the vacancy caused by the recent death of Matthew Gault.

GEORGE T. BEATTIE, highway engineer, U. S. Bureau of Public Roads, has been transferred from Washington to the district office at Missoula, Mont.

R. L. RICHARDS, engineer of Douglas County, Wash., has resigned to take a Government position in Alaska.

M. O. LEIGHTON, C. T. CHENERY and A. C. OLIPHANT have formed a partnership under the name of M. O. Leighton & Co., with offices in Washington, D. C., for the purpose of engaging in general engineering practice and industrial representation before the Federal departments. Mr. Leighton and Major Chenery will continue for the time being as chairman and secretary of the National Public Works Department Association, while Mr. Leighton and Mr. Oliphant will continue service in the Washington office of Engineering Council, pending the displacement of that body by the Federated American Engineering Societies.

A. C. IRWIN, structural engineer for the Portland Cement Association, has resigned as chairman of the national qualification committee of the American Association of Engineers after continuous service in that capacity for over two years.

B. E. MOONEY, of Rexford, Mont., has been appointed city engineer and water commissioner of Whitefish, Mont.

EARL STAFFORD has become a member of the engineering staff of Arthur D. Little, Inc., Cambridge, Mass.

W. A. MURRAY, division engineer, New York Central lines east, with headquarters at Albany, N. Y., has been made engineer of track, at New York; G. N. EDMONDSON, division engineer, Pennsylvania division, at Jersey Shore, Pa., has been transferred to Albany succeeding Mr. Murray; S. E. ARMSTRONG, division engineer, Ontario division, at Oswego, N. Y., will succeed Mr. Edmondson at Jersey Shore; N. W. MCCALLUM, electrical supervisor of bridges and buildings, at New York, has been appointed division engineer at Oswego succeeding Mr. Armstrong.

HERBERT POST GREEN has opened an office in New York City, as the president of Herbert Post Green and Associates, Inc., architects, engineers and cost engineers. Mr. Green has associated with him, as vice-president, E. B. Black, of Black & Veatch, consulting engineers, Kansas City, and John C. Prior, of Braun, Fleming, Knollman & Prior, consulting engineers, Columbus, Ohio. Branch offices of the company will be in each of the two latter cities. There is also in the concern Austin W. Lord, of the architectural firm of Lord & Hewlett, New York City, and W. S. Manning, a landscape architect of many years' experience. The company will not only be engaged in regular design, construction and appraisal engineering, but is to offer a new service known as cost engineering service, to be rendered as professional service to the architect or engineer, the owner and the contractor. The company will act as an arbiter in the interests of the owner and of the contractor, so that the benefits of their service inure to both. Mr. Green and Mr. Prior were connected with the cost engineering end of the U. S. Housing Corporation.

E. V. BARON, project engineer, Attalia (Wash.) Irrigation District has completed construction work in that district and is now in charge of construction in the recently organized Priest Rapids Irrigation District, with headquarters at White Bluffs, Wash.

T. J. WILKERSON has resigned as chief engineer of the Penn Bridge Co., Beaver Falls, Pa. About Sept. 1, he will open a consulting engineering office in that city, giving particular attention to the design of steel and reinforced-concrete structures and the layout of factories. Previous to his connection with the Penn Bridge Co. in 1917, Mr. Wilkerson for nearly ten years was division engineer in the Pittsburgh division of bridges.

CHARLES E. HENDERSON, formerly assistant city engineer of Port Arthur, Ont., later city engineer of St. Augustine, Fla., and during the war principal assistant engineer with the U. S. Housing Corporation, at Washington, D. C., has been appointed division engineer in charge of the Detroit office of Morris Knowles, Inc., Burns Building, that city. Mr. Henderson is also manager of Morris Knowles, Ltd., of Windsor, Ont.

CLARK KEITH, formerly engineer in charge of design and construction for the municipality of Moose Jaw, Sask., now of Morris Knowles, Ltd., of Windsor, Ont., has been appointed assistant chief engineer of the Essex Border Utilities Commission, having jurisdiction over the water supply, sewerage and park systems of the seven municipalities bordering on the Detroit River.

WALTER J. TOWNE, engineer of maintenance, Chicago & Northwestern Ry., with headquarters at Chicago, has been appointed chief engineer, succeeding the late L. J. Putnam. From 1899 to 1902, Mr. Towne was assistant engineer of construction at Boone, Iowa, Kaukauna, Wis., and Escanaba, Mich. He was made division engineer, at Baraboo, Wis., in 1902, division engineer at Escanaba in 1904, from 1904 to 1906 division engineer at Chicago, and from March to July, 1906, engineer of permanent improvements. From that date until 1912 he was engineer of maintenance of way; appointed assistant general manager and general superintendent in 1914, and reappointed engineer of maintenance March, 1920.

G. A. RUSSELL, assistant county highway engineer, has been appointed engineer of Geary County, Kan., succeeding DeWitt C. Mickey, resigned.

J. ALBERT HOLMES, of Boston, is resident engineer for Pearse & Greeley, hydraulic and sanitary engineers, Chicago, on the construction of a new earth dam at Decatur, Ill., a $750,000 job. Mr. Holmes has recently been resident engineer for the J. G. White Engineering Corporation on the construction of the four earth dams recently completed in North Carolina for the Western Carolina Power Co.

BUSINESS NOTES

J. D. ADAMS & CO., manufacturer of roadbuilding and maintenance machinery, Indianapolis, has established new branches at Dallas, Tex., Kansas City, Mo., and Minneapolis.

A. PEARSON HOOVER, formerly lieutenant-colonel, Construction Division, U. S. Army, has been elected a vice-president of Holbrook, Cabot & Rollins Corporation, contractors, Boston and New York.

THE AIR REDUCTION SALES CO., New York, has just completed the construction of a new acetylene plant at Gloucester, N. J., consisting of a gas house, carbide storage building and a generator house.

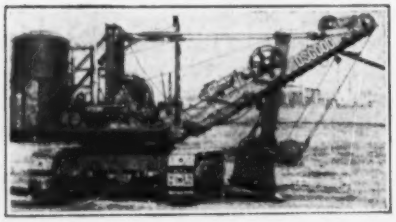
THE THEW SHOVEL CO. and the Thew Automatic Shovel Co., Lorain, Ohio, have been consolidated. The Thew Shovel Co. has assumed all the assets and business of the Thew Automatic Shovel Co. The officers of the consolidated company are: President, F. A. Smythe; vice-presidents, H. H. Harris and A. B. Taylor; secretary, C. B. Smythe; treasurer, R. B. Miller; sales manager, H. E. Billington; general works manager, J. S. Small, and purchasing agent, H. B. Newton.

A. A. E. Forms Industrial Department

The success of the railway department of the American Association of Engineers has led it to form an industrial department which is headed by A. M. Cornell, chief engineer, Pettibone & Mulliken Co., until such time as the duties warrant a full-time secretary. The new department will take up the problems in the field of mechanical, electrical and chemical engineers.

Revolving Shovel Operates in Small Space

An especially designed revolving air shovel mounted on continuous tread trucks is the Osgood 18, manufactured by the Osgood Co., Marion, Ohio, and reproduced herewith. The shovel is equipped with but a 12½-ft. boom and a 7-ft. dipper handle and is designed for low overhead clearance work. The entire height of the shovel is 10 ft., and the rear end swinging radius 7 ft. 9 in. One of these shovels is now doing underground quarrying, operating in a space only 11½ ft. high.



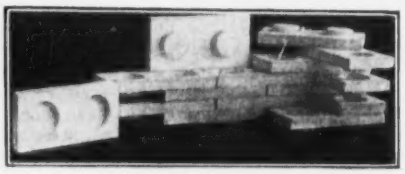
SPECIALLY DESIGNED SHOVEL FOR LOW OVERHEAD CLEARANCE WORK

New Horizontal and Vertical Skip Hoist

A combination of the vertical and horizontal operation of a skip hoist has been developed in a new machine called the "balanced skip hoist transporter," which is being marketed by the Exeter Machine Works, Inc., New York City. This skip is covered on all sides except for an opening in the upper part of the front side for receiving its load and single- or double-hinged doors on the opposite side for discharging the load when the skip is running on a horizontal track. The entire weight of the skip and half its load is balanced by a counterweight which operates only during the vertical motion of the skip Typical layouts are available in which the combination of the two movements permit many different types of installation.

Interlocking Building Brick

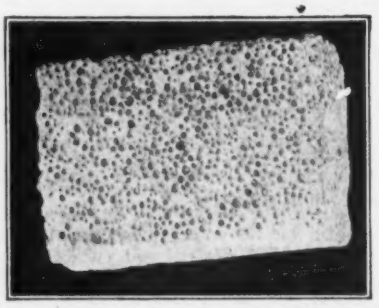
A new interlocking brick for large and small building construction is made with two circular pockets on the upper face and two circular projections on the lower face, as shown in the accompanying cut, but this view represents plaster models, the real bricks being of standard size and thickness. Bricks of this form are being made in San Francisco and are to be used in a $250,000 school building, but strikes in the brickyards have delayed production. This interlocking and self-bonding construction is said to be of special advantage in hollow-wall work. Tests are being made by the U. S. Government. It is the invention of Charles H. Brisbin, Brisbin Brick Co., Yuma, Ariz.



MODELS OF INTERLOCKING BRICK
(Actual bricks are of standard thickness)

A New Light-Weight Concrete for Roofing and Siding

"Porete," a cast concrete of extreme lightness, has recently been put on the market by the Porete Mfg. Co., Newark, N. J., mainly for roof decking or sidings to which to apply stucco. The distinguishing features of the product aside from its lightness are its strength and the fact that it can be nailed to studding. The material, a sample of which is shown in the view herewith, is a concrete made up of cement and fine sand, with many connecting holes or pores formed by the dissolving of a number of soluble pellets which are incorporated in the mixture. These pellets are dissolved by a steam bath process and their essential liquid recovered for future use. At present "Porete" is supplied in 24 x 32 in. slabs, 1 in. thick for sheathing and 1½ in. for roofing, both being reinforced with wire netting. The 1½ in. roofing slab weighs with a ⅛ in. cement finish, 7 lb. per sq.ft. and in test specimens have broken at 250 lb. per sq.ft. over a 32 in. free span. In application the slabs are nailed to wood studs or clipped to steel beams or purlins and the outside porous surface stuccoed. Due to the interlock the stucco holds admirably to the porous face. The other face is finished smooth if required.

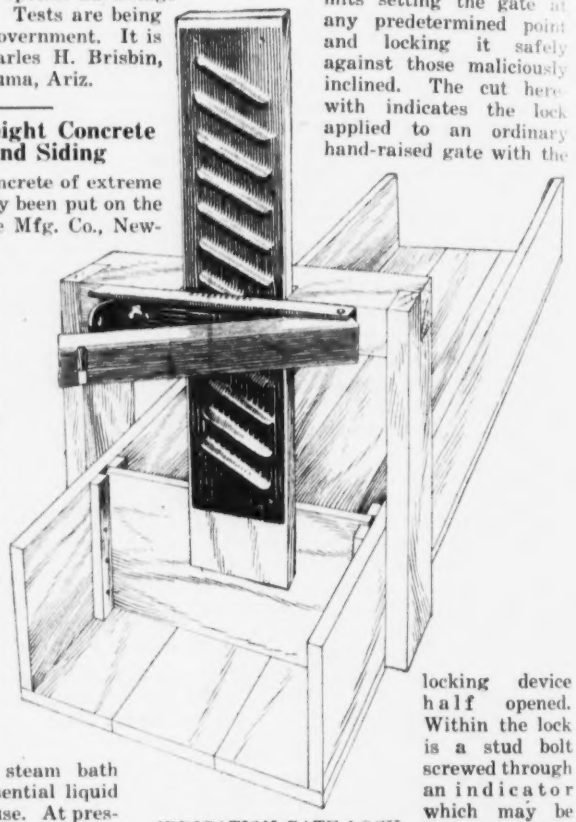


LIGHT-WEIGHT CONCRETE "PORETE" MARKETED FOR ROOFING AND SIDING

The process of manufacture has been patented.

Combined Gate Lock and Gage

As an aid to operators of irrigation properties a combined gate lock and gage has been devised which permits setting the gate at any predetermined point and locking it safely against those maliciously inclined. The cut herewith indicates the lock applied to an ordinary hand-raised gate with the locking device half opened. Within the lock is a stud bolt screwed through an indicator which may be moved horizontally permitting the gate to be raised the sloping distance between the corrugations. If a greater opening is desired the bolt is farther withdrawn and the gate lifted to approximately the position desired. Since each corrugation is numbered and a horizontal scale is provided for the fine adjustments, exact quantities may be measured. This permits resetting accurately and the making up of tables to give exact quantities. The usual method is to bore two or more rows of staggered holes in the stem, through which a pin or bolt is inserted. No fine adjustment is possible.



IRRIGATION GATE LOCK PERMITS FINE ADJUSTMENT

The device has been designed and patented by F. N. Cronholm, general superintendent, river division, Imperial Irrigation District, Andrade, California, who states that several thousand are in use.